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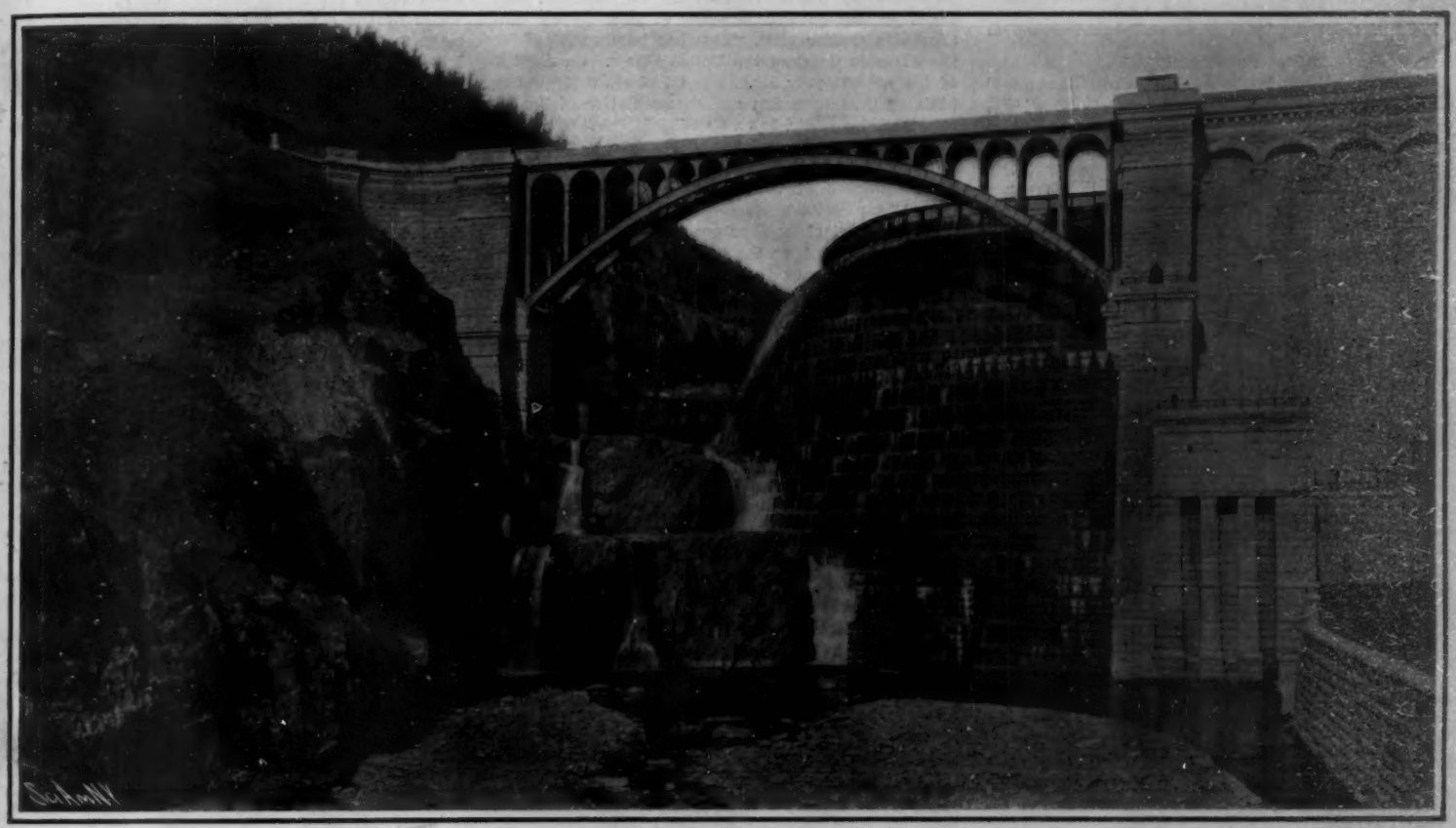
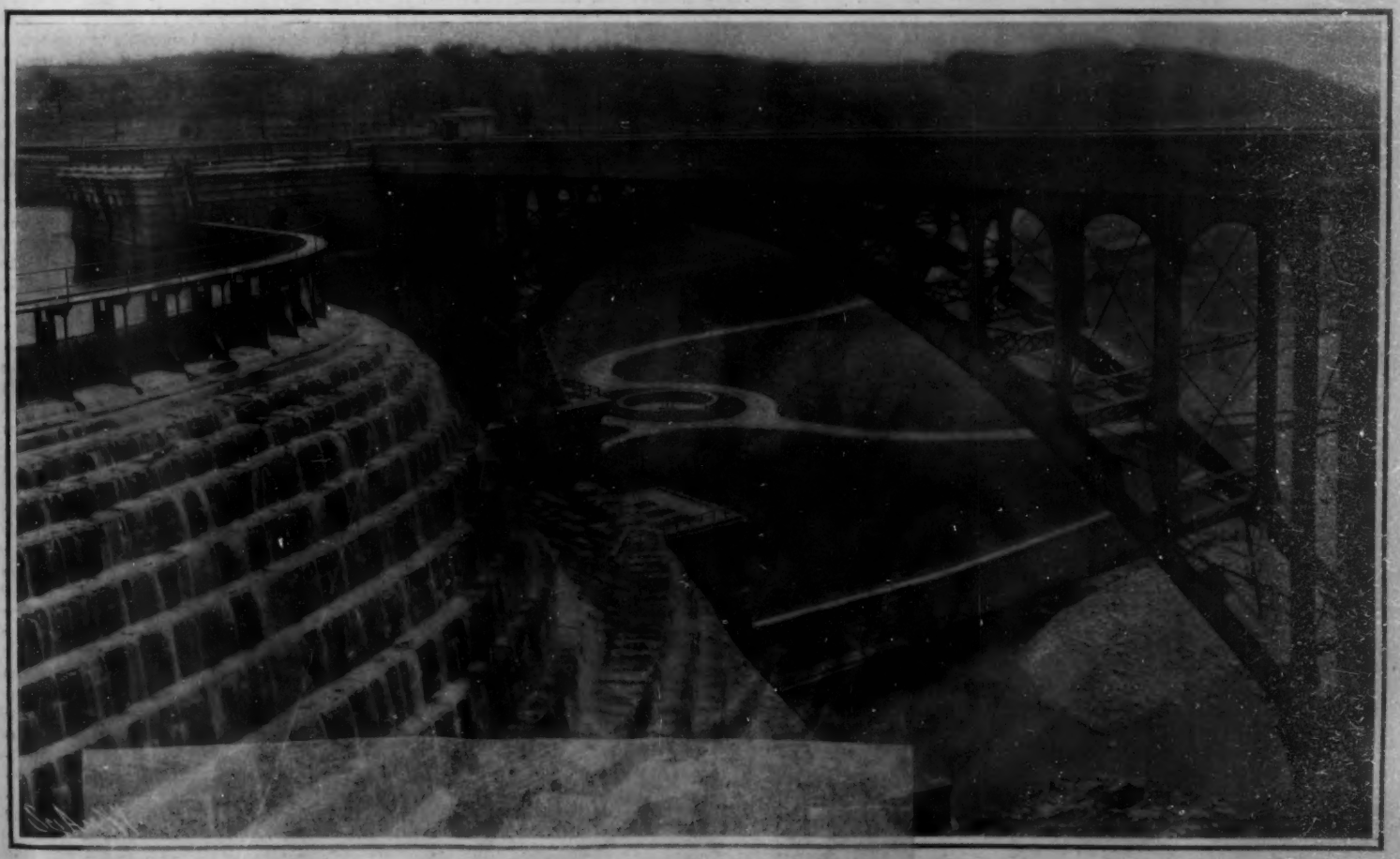


The height of this artificial waterfall is but a few feet less than that of Niagara Falls.

The Spillway of the Croton Dam, With One Inch of Water Flowing Over.



The Fine Steel Arch Spanning the Spillway of the Croton Dam.

MAXIMUM ECONOMICAL STORAGE CAPACITY OF CROTON WATERSHED.—[See page 369.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, MAY 23, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PRESIDENT ROOSEVELT ON THE CONSERVATION OF OUR NATURAL RESOURCES.

The publication on another page of this issue of some photographs which show very dramatically the extent to which our natural resources are being depleted in a certain section of the South, has a timely relation to the recent remarkable gathering of Governors at the White House, and the able address made by President Roosevelt on this, "the weightiest problem now before the nation." In his opening words the President drew attention to the fact that, when the founders of this nation met at Independence Hall, the conditions of commerce had not fundamentally changed from what they were when the Phœnician traders first sailed the waters of the Mediterranean. In the interim, however, our knowledge and use of our natural resources have increased a hundredfold, and the resulting growth of this nation has been due mainly to the rapid development and, "alas that it should be said, to the rapid destruction of our natural resources."

One of the pronounced national traits of the American people is their appreciation of, and pride in, the vast extent of their country and its supposedly "illimitable" resources. It has been our frequent boast that, within our borders, were to be found fertile lands capable of supporting all of the people who might feel drawn to make this country their home; and yet it is a fact that to-day, outside of that which may be rendered fertile by irrigation, there is but little agricultural land remaining unoccupied. "We began with an unapproached heritage of forest; more than half the timber is gone. We began with coal fields more extensive than those of any other nation, and with iron ores regarded as inexhaustible; yet many experts now declare that the end of both iron and coal is in sight. The enormous stores of mineral oil and gas are largely gone. We began with soils of unexampled fertility; yet we have so impoverished them by injudicious use and by failing to check erosion, that their crop-producing power is diminishing."

No thoughtful mind, in its contemplation of the phenomenal growth of this country, will deny that it is due largely to the overlavish use of our resources, and that the migrations of our pioneer people, in their depletion of the natural wealth of the country, have been not unlike the flight of a swarm of locusts across a fruitful land. We have eaten up our capital with the lavish prodigality of a youthful and thoughtless heir to some rich and suddenly-inherited estate. The time has, indeed, come to "inquire seriously what will happen when our forests are gone; when the coal, the iron, the oil, and the gas are exhausted; when the soil shall have been still further impoverished and washed into the streams, polluting the rivers, denuding the fields, and obstructing navigation."

Happily, the nation as a whole is at last awakening to a realization of the vital importance of this question, and there are many signs that, if judicious legislation be proposed, looking to the conservation of our natural resources for the benefit of the State as against the individual, of succeeding generations as against the present individual holders, it will receive the support of powerful majorities both in the State and Federal legislative bodies. The President made reference to recent instances of legislation which show that the nation is coming to a realization of the true significance of this question. The first of these was a judicial decision rendered by the Supreme Court of Maine on March 10 of this year, in response to questions as to the right of the Legislature to restrict the cutting of trees on private lands, with a view to the prevention of droughts and floods, the preservation of the natural water supply, and the prevention of erosion, with its consequent silting up of rivers. The opinion of the Maine Supreme Bench upholds the principle that the property rights of the individual are subordinate to the rights of the community, and that the waste of wild timber land derived originally from the State, involving as it would the impoverishment of the State and its people, thereby defeating one great purpose of the government, may properly be prevented by State restriction. Furthermore, the Court of Errors and Appeals of New Jersey has adopted a similar view, which has been sustained by the Supreme Court of the United States. On April 6 of the present year Mr. Justice Holmes said: "The State as quasi-sovereign and representative of the interests of the public, has a standing in court to protect the atmosphere, the water, and the forests within its territory, irrespective of the assent or dissent of the private owners of the land most immediately concerned."

That the principles thus enunciated are not in any sense Utopian, but, on the contrary, are perfectly practicable, is shown by the good results which have followed government control in some foreign countries, instances of which are given in the article on "Forest Destruction and the Erosion of Arable Land," already referred to as published on another page of this issue.

SAFETY OF THE BLACKWELL'S ISLAND BRIDGE.

It was inevitable, when the chords (the bottom compression members) of the Quebec Bridge failed, letting the whole structure collapse into the river, that the question of the security of similar compression members in other large bridges built on the same principles of design should be raised, and a certain amount of anxiety aroused as to the safety of these structures. The Quebec Bridge was an enormously heavy structure; but it is not generally known that there is one other great cantilever bridge that is heavier than the fallen bridge, and that is the new Blackwell's Island Bridge across the East River in this city. The Forth Bridge weighs 10½ tons per linear foot; the Quebec Bridge, 13 tons per linear foot; and the Blackwell's Island Bridge, 13½ tons per linear foot.

The chord members of the Quebec Bridge which failed consisted of four flat webs, or diaphragms, each made up of several plates riveted together, the webs being in vertical planes and held together by a horizontal trussing of light angles, riveted along their top and bottom edges. As we have already shown in this journal, the chords failed because this latticing was not sufficiently strong to hold the four webs in their proper planes. The latticing was torn asunder, and the webs, bending laterally out of line, were buckled into the form of a huge letter S. The chord failed under a load of 18,000 pounds to each square inch of section in the webs. The Royal Commission that investigated the disaster built a chord member that was one-third the size of the Quebec Bridge member, but was in other respects exactly identical. It was placed in a testing machine, and loaded until it failed in exactly the same way as the Quebec chords, and failed moreover under exactly the same load of 18,000 pounds to the square inch.

It is universally accepted by engineers that the chords collapsed because of the insufficient means provided to hold the web members in true line.

Now, to return to the Blackwell's Island Bridge. Before former Bridge Commissioner Lindenthal went out of office, plans had been completed for this bridge, which called for chord members 60 inches in depth, consisting of three leaves, or webs, held firmly in position by a continuous top steel cover plate, extending over the full width of the chord and throughout its whole length. There was further reinforcement consisting of latticed trussing on the bottom face of the chords; and they were still further insured against lateral deformation by riveting them to the steel plate floor of the bridge. On the next Commissioner taking office, it was decided to add two more railway tracks to the bridge, and, of course, the addition of this large amount of extra weight necessitated a recalculation of the stresses. In the new plans the live load, it is alleged, was raised from 12,600 pounds per linear foot to 16,000 pounds, and the dead load, it is further alleged, was raised from a total of 84,000,000 pounds to 103,000,000 pounds. To provide for this additional weight, a corresponding increase was made in the section of the various tensional and compression members throughout the bridge.

Unfortunately, as it seems to us, a radical change was made in the design of the bottom chords. The excellent arrangement of a continuous cover plate (we have always urged the use of cover plates in place of the unreliable latticing in large members of this kind) was rejected in favor of a four-leaved bottom chord, broadly similar to that in the Quebec Bridge. Unfortunately, it was decided to construct this bottom chord in two sections, latticing together each pair of leaves independently, and then tying the two halves of the chord together by means of flat tieplates, spaced at intervals, between the two inside leaves. Also the steel floor was not riveted to the chords, and the latter was deprived of the great stiffness thus afforded. Now, while this separation of the chord into two halves made the work of manufacture and handling simpler for the bridge company, it seems to us that it was the worst possible change that could have been made for the safety of the bridge. The construction is not even as good as that adopted in the Quebec Bridge; for in those chords the lattice trussing did extend the full width of the chord, and secured all the additional strength due to this width; whereas in the Blackwell's Island Bridge each system of latticing extends across only about one-third the width of the whole chord, or say about 2 feet; and any graduate of a technical night school will understand that the stiffness of two trusses each two feet in depth, added together, does not approach that of a single, unbroken system of trussing having a width of over five feet. It is true the length between chord pins is less in the Blackwell's Island Bridge, but this is offset by the fact that the webs in the Blackwell's Island Bridge are composed of thinner plates and connected by fewer stitch rivets.

This faulty construction is only one of many evidences of a grave defect in our system of bridge construction as such, namely, that convenience of shop construction and considerations of cheap cost are permitted to exert too controlling an influence upon the whole design of the bridge itself.

The Quebec Bridge chords failed under 18,000 pounds to the square inch. They measure in exterior diameter 5 feet by 5 feet 6 inches, and the latticing extended the full width of the chord. The Blackwell's Island chords measure only 4 feet by 5 feet 10 inches in extreme diameter; the latticing extends unbroken over a width of not more than two feet, and yet the stress per square inch is to be 2,000 pounds greater than that under which the Quebec Bridge failed, or 20,000 pounds total.

Now the SCIENTIFIC AMERICAN has no desire to play the part of alarmist in this matter; yet we do without hesitation state that the above conditions are so serious as to call for a most thorough investigation of the actual stresses now existing, and that will exist when the bridge is under its maximum possible load. In view of what has transpired in the Quebec Bridge investigation, we believe that it is the duty of the authorities to reinforce the bottom chord, and probably some of the other main compression members, before the bridge is open to the public. This reinforcement should take the form either of a continuous cover plate, or, if that be impossible, of some system of longitudinal internal diaphragms built in between the chord leaves. It will, of course, be impossible to cover-plate the whole width of the chord, since this would involve the temporary removal of the present latticing, a step which, under the existing heavy dead load, would mean the collapse of the chord. It may be possible, however, to replace the present tie-plates between the two inner leaves by a continuous cover-plate, thus insuring that the two independent systems of latticing shall act as one. In addtion to this, it would be possible to rivet heavy stiffening members along the outside leaves at their middle depth.

But after all said and done, the first fact to be ascertained is just what is the compressive value of this form of divided chord. This could be accomplished by actual tests with models, as was done by the Royal Commission in their investigation of the Quebec Bridge disaster. In fact, without such a test, it is impossible to tell whether this chord would fail with 16,000, 20,000, or even 30,000 pounds to the square inch. There is absolutely no record of tests which throw any clear light upon its bearing value.

A CITY OF TOWERS.

The economical advantages which result from the construction of office tower buildings, such as the Singer and the Metropolitan, which are now under construction in this city, make it certain that unless restrictive legislation be enacted, buildings of this character will continue to be put up just as fast as the owners can find the necessary capital and see a sure prospect of adequate financial returns. The chief objection to such buildings lies, of course, in the fact that they shut out light and air from adjoining property; and the conviction is steadily growing that the question should be made one of careful legislative control. The best discussion of this really very vital subject is that by Mr. Ernest Flagg in the American Architect, where he sums up his proposal for control and restriction under four propositions. First: He would limit three-quarters of the area of every plot to a building height not to exceed once and a half the width of the street on which it faces, with a maximum height of one hundred feet. Secondly: He would have no limit of height for the remaining quarter of the plot,

provided that no building or part of a building should be carried above the limit mentioned within a distance of the street façade equal to the distance of the curb from the building line. Thirdly: He would allow of the purchase and sale between adjoining owners of the right to build high within the limit stated. And lastly: He would require that all sides of any structure carried above the limit of height should be treated architecturally, and that no wood whatever should be used in the construction of the entire building or its equipment.

PROGRESS OF THE WRIGHT AEROPLANE EXPERIMENTS.

Soon after the first reports were received from Manteo, on Roanoke Island, regarding the flights being made by the Wright brothers in testing their aeroplane, a considerable number of newspaper correspondents visited the scene of the trials, which is among the high and pointed sand dunes of the North Carolina coast on a long strip of land that extends from Cape Henry, near Norfolk, Va., southward some 80 miles.

The brothers refused to make any flights, however, when the reporters were near at hand, and so the gentlemen of the press were obliged to keep in hiding nearly a mile away from the scene of operations, and to merely watch the machine from afar through spyglasses when it was flying. Although no close view could be had of it, the spectators saw the aeroplane numerous times in flight, and were able to form a good idea of its general appearance and construction. The machine used in the experiments is said to be the old one which was taken apart in 1905, while the motor is claimed to be practically a more powerful French-made duplicate of the one with which the flights were made in that year.

Although it is presumably supplied with a suitable radiator for cooling the water, yet it seems to have given trouble from overheating. Doubtless this defect will be readily remedied, however.

On Monday, the 11th instant, the machine is said to have made two flights of about 2 7/16 and 2 1/16 miles respectively. The first of these flights was made at about 9:15 A. M. The machine started from the foot of Kill Devil Hill, and flew in a northerly direction almost parallel with the beach for 1⅝ miles, after which it turned to the westward for 5/16 of a mile, and then returned to the starting point in a southeast direction, covering a distance of about ¾ of a mile more. The distances were computed from the telegraph poles ranged along the beach. The time of this flight is given as 3 minutes and 7 seconds, which corresponds to an average speed of 46.91 miles an hour. Another flight over practically the same course was made, the distance covered in this instance being only 2 1/16 miles, and the time being 3 minutes and 50 seconds. Instead of making the second turn, as in the first flight, the machine kept straight on until it was close to the water, when a landing was made. The aeroplane was started from a rail as heretofore. It was placed upon a small carriage, which supported it until sufficient speed was attained for it to rise in the air. It therefore still has the disadvantage of having to be carried back to this rail in order to start. It was transported back by a pair of wheels, which were placed beneath it, after which the engine was started, and the propellers were made to push it along on the wheels over the sand.

After these successful demonstrations on Monday, the inventors busied themselves working at their machine on Tuesday, and the following day they were out again early in the morning. This time both of the brothers could be seen seated in their aeroplane, and they could not have been any more elated at their successful flight than were the onlookers who viewed them from a distance, and who realized that these two young Americans were, in reality, the first men to ever fly together for any distance in a heavier-than-air machine. The first flight was made about 8:30 A. M. The machine is said to have covered about ¾ of a mile in 1¼ minutes, and to have come to earth in an attempt to clear a tree that stood in the midst of the sandy waste. So sudden and violent was the descent, that much sand was sent flying as the machine landed. The second flight made on this day was considerably better. The start of this flight occurred just before noon. During this flight the machine is said to have dropped from an elevation of about 30 feet to a distance of some 10 feet above the ground, and then to have followed up the side of Nag Head Hill (which is about 40 feet high), over the top of this hill, and down on the other side, thus showing its ability to rise and fall with ease and follow the contour of the land over which it is flying. The distance covered in this flight is said to have been about three miles, and three excellent turns were made. According to the reports, there was a stiff breeze of from 15 to 20 miles an hour blowing at the time these flights were made. Two other flights up the coast and back, each of which is estimated to have been 4 miles or more in length, were made. The machine traveled so far, that it was almost out of range of the spyglasses of the watchers. The strong wind which was blowing apparently had no effect upon the machine.

On Thursday three excellent flights were made without mishap. In one of these, Mr. Orville Wright operated the aeroplane, and took as passenger his assistant, Mr. Furness. A perfect circle was made around one of the sand hills, a distance of nearly 2 miles being covered in 2 minutes and 38 seconds. The machine was brought down within a few yards of the starting point, and was managed with great skill. The final flight was made with Mr. Wilbur Wright alone in the machine. Starting from a point near the shed, the aeroplane traveled some 3 miles up the coast and back again, completing a circuit of nearly 6 miles. It had almost reached the starting point when, instead of rising and passing over a sand dune which was in the way, it plunged down from a height of some 30 feet and was demolished. The operator escaped with a few scratches. From all that could be learned, the accident resulted from a change in the operation of the steering device, which caused the aviator to make a wrong move at a critical time. The Wright brothers expressed themselves as satisfied with the operation of the machine, however, and they have shipped what remains of it back to their home in Dayton, O., where they expect to incorporate the knowledge they have gained in the machine which they have contracted to deliver to the government in the next three months, or by August 28.

In view of these semi-public demonstrations, there can be no further doubt of the claims made by the brothers as to their ability to fly; and in all probability they will succeed in fulfilling the strenuous conditions which the War Department has prescribed. In view of the requirement that the machine should carry two men, which has already been fulfilled by the Wrights, it is interesting to note that on the 9th instant Henry Farman is reported to have flown some 700 feet with his father as a passenger, and with 8 gallons of water for cooling the motor and 2.6 gallons of alcohol for fuel.

POSTAL RAILWAY IN BERLIN.

A dispatch from Berlin to the London Times states that the German post office department has put forward a scheme to connect the general post office in that city with the various branch offices by the construction of an underground railway, by means of which the more rapid distribution of the mail bags to and from the main trains will be effected at a speed of about 25 miles an hour. The railway will be worked without a guard or driver, and the tunnel, which will be placed close beneath the road surface, is to be only 29 inches in height by 71 inches in width. Each truck or car is intended for the conveyance of a large-sized mail bag. The train will be composed of a dwarf electric locomotive and not more than four trucks. The locomotive will have a pair of axles, each furnished with a motor. The line will be double-tracked throughout and will have a 16.13-inch gage. Over each track will be conductor rails. A trench will be provided between the two lines of rails, so that a man will be able to pass through the tunnel. The railway is to be operated by electricity. The construction of these tunnels for distribution of mails, the dispatch says, is regarded as a matter of certainty, as the negotiations between the postal authorities and city of Berlin have already been concluded.

EXPERIMENTS WITH A POSTAL AUTOMOBILE IN FRANCE.

The French post office department has lately conducted some experiments with a postal automobile, which gave excellent results.

The test was made at Lorris in the department of Loiret, with a closed touring car furnished by the De Dion-Bouton Company, and it extended over a period of two weeks from the 15th to the 30th of January last.

The post office at Lorris has eleven postmen, who are obliged to deliver mail in the city and in the surrounding suburbs of Moutereau, Cour-Marigny, Chailly, Coudray, Chataenay, Noyers, Vielles-Maisons, and Grignon. Despite the fact that the postmen are supplied with bicycles, it is nevertheless difficult to give good service on account of the large amount of mail. As a consequence, most of the suburbs have only one delivery a day.

The experiment was carried out in the following manner: Five of the postmen were located permanently in the suburbs of Moutereau, Cour-Marigny, Chailly, Coudray, and Chataenay. Each morning the automobile started at seven o'clock and made the rounds of these suburbs, delivering to the various postmen their mail pouches. Upon receipt of the pouches, the postmen immediately began delivering the mail. The automobile also collected from the postmen the pouches filled with outgoing mail, and was able to deliver these at Lorris at 9:15 A. M., in time for the mail leaving at that hour for Montargis, a place some thirteen miles distant, to which the mail is conveyed by a horse-drawn omnibus.

The experiment proved that by using an automobile in this manner, the services of several postmen could be dispensed with, and that two deliveries and collections per day could be readily made, the first delivery being a half hour earlier than before. This method of delivering mail makes it necessary for the postman to be on hand when the automobile arrives, and thus puts a check upon him. During the fifteen days of the test, although the train was always late in arriving at Lorris, the automobile finished every trip on time.

PROTECTION FOR PATENTS AND TRADE MARKS OF GOODS TO BE EXHIBITED.

Ambassador Thomas J. O'Brien, of Tokyo, transmits an extract from a Yokohama newspaper containing a reply from Viscount Kaneho, director of the exhibition executive, to a communication from the Yokohama Foreign Board of Trade relative to the protection of inventions, trade-marks, etc., of articles to be exhibited at the world's fair in Japan in 1912. The director writes:

"According to the provisions of the present patent law, models of utility law, designs law, and trade-marks law, when notice is given to the patent office before installing such articles in the exhibition, if application for patent or registration has been made within six months from the day of receipt of said articles at the exhibition, such application shall have the same validity as if it had been filed on the same day as the original notice. From this it will be seen that there will be no danger for any invention installed in the exhibition to be regarded as 'publicly known,' which on that account will properly secure the rights of the inventor, while with regard to designs, models of utility, and trade-marks, after one has given notice concerning them to the patent office, as aforesaid, he shall enjoy a prior right to them. So that by enforcement of these laws we feel a proper protection for foreign exhibits is already assured. But in order to render the rights of foreign exhibitors more secure, and also to make it easier for them to send articles for exhibition, the Imperial Government has already decided to introduce in the present session of the Diet a bill for that purpose, etc."

THE CURRENT SUPPLEMENT.

The Boscoreale relics are discussed in the opening article of the current SUPPLEMENT, No. 1690. Nilsson's and Burbank's methods in plant breeding are discussed by Prof. Herbert Maule Richards. The well-known French authority on bees, Gaston Bonnier, writes most exhaustively and instructively on organized anarchy among bees. A recently-issued British naval report contains a memorandum on the subject of caisson disease, an abstract of which memorandum is published. K. H. Floering writes on a rotary field model, the advantage of which is to present graphically the well-known wave diagrams employed to illustrate the theories of electromotive forces and currents. The Hon. C. A. Parsons and Alan A. Campbell Swinton contribute a paper on the conversion of the diamond into coke in vacuum by cathode rays. R. G. Skerrett shows how far the Italians have progressed in the matter of submarine navigation. From his account it would seem that their submarines are far in advance of other foreign submarines. The weathering of coal is discussed by S. W. Parr and N. D. Hamilton. The subject of malleable iron castings is treated by C. H. Gale. How the metropolitan tunnel in Paris was constructed with the aid of the Pifre erector is well described. Dr. Koller shows how gold and silver residues may be recovered.

SENDING WIRELESS MESSAGES TO A BALLOON.

On May 13 several officers of the Signal Corps, with Lieut. Frank P. Lahm as pilot, made an ascent in one of the army balloons from Washington at 1 P.M. and landed at Patuxent, a small place near Baltimore, at 4:10. During the course of the flight, messages were received on board the balloon from the government's wireless station at Annapolis. A special antenna was suspended from the basket, and the latter was also enveloped in a wire netting. So successful was the experiment, that Major Russell believes that balloons will soon be equipped with wireless apparatus, which will enable them not only to receive messages, but also to send them. With this improvement, the use of the balloons will be greatly increased in time of war.

The number of bicycles imported into Switzerland in 1906 was 20,229, a decrease of 721 on the imports of 1905; of these Germany supplied 17,000; France, 2,284. The number of British-made machines imported was only 391, an increase of 91 as compared with 1905. The trade in American bicycles decreased from 120 in 1905 to 53 in 1906.

THE USE OF THE AIR BRUSH IN THE DECORATION OF WALL PAPER AND FABRICS.

BY JACQUES BOYER.

The air brush was invented in the United States a number of years ago and was first employed in coloring photographic enlargements. The original apparatus was quite complicated, difficult to manage, and of little durability. Hence the air brush or spray method could not be generally employed in factories for the production of black or colored designs and decorations until after the invention of simpler and more solidly constructed apparatus.

There are now in use in French factories several types of air brush with which liquid pigments of all sorts, from alcoholic solutions of aniline dyes to the thickest oil paints, can be satisfactorily applied. Decorators and photograph retouchers use a very small apparatus which works easily and perfectly in either the vertical or the horizontal position. The accessories include a compressing air pump, which is operated by the foot, a compressed air reservoir, and a pressure gage. The reservoir having been charged to the requisite pressure, the air brush is grasped with the right hand like a pencil, with the forefinger resting on the button which controls the air and efflux valves, and the hopper is filled with liquid color.

To produce the spray, a current of compressed air is admitted by pressing the button. The size of the jet is regulated by drawing back the button more or less and thus opening to a corresponding extent the orifice of efflux. The width and intensity of the colored band produced in this manner are determined by the distance between the air brush and the work. Fine lines are traced by putting the instrument very close to the fabric or paper and drawing back the button very slightly, while broad tints and shadings are made with the air brush at a considerable distance from the work.

Veyron's improved air brush (Fig. 1) is shaped and handled like a pistol, the valves being operated by a trigger beneath the barrel. It can be used in any position.

In factories, the air pump worked with a treadle is often replaced by a tube communicating with a central reservoir of compressed air, and the designs are made with the aid of masks or stencils cut out of sheet metal. One of the photographs shows women engaged in decorating fabrics for cravats, scarfs, shawls, cushion covers, and other small articles. Each woman, standing before a vertical board on which the fabric is stretched, applies the stencils with her left hand and operates the air brush with her right. When the area of the board is finished, she turns the wooden cylinders at the ends of the board on which the plain and the decorated ends of the goods are rolled, bringing a fresh portion in front of the board. The entire work is planned in advance and the fabric bears marks which guide both the decorator and the cutters, to whom it goes after the designs have been fixed.

The operation of fixing is performed in an autoclave (Fig. 3). This is a large vessel heated by steam both inside and outside, but in such a manner that steam cannot condense on the goods and cause spotting. The goods having been placed in the vessel and the door closed, dry steam is introduced and the color is attached firmly to the fibers by the combined influence of heat and chemical action. The fixing is the most delicate and important operation of the entire process and it requires a profound knowledge of chemical and physical laws and properties, as the duration of the operation and the temperature and pressure of the steam must be varied according to the fabrics and pigments employed.

After the colors have been fixed, the goods are washed with soap and water, to remove the gum and other substances that had been mixed with the pigments, and are dried in the air. Finally, they are subjected to a process of dressing or finishing. Post cards, boxes, calendars, pamphlet covers, and other objects of paper and cardboard are decorated in nearly the same manner, but without fixing (Fig. 4.) Porcelain, wood, leather, and other materials are also decorated with the air brush, which produces delicately graduated tints without any blurring. Compound tints are easily and successfully obtained by superposing simple colors.

Fig. 1.—Veyron's Improved Air Brush.

Fig. 2.—Decorating Fabrics with Air Brush.

Fig. 4.—Decoration of Cards with the Air Brush.

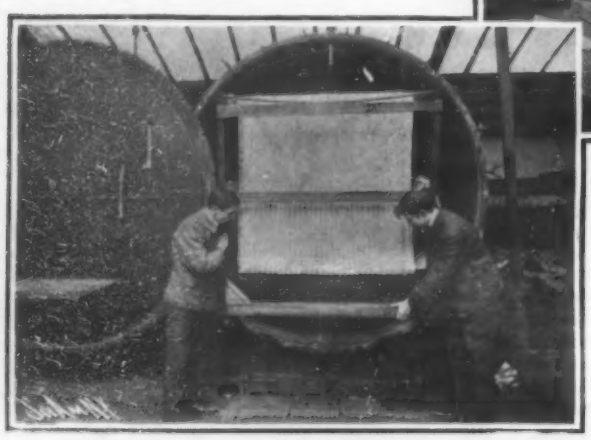


Fig. 3.—Putting Decorated Fabrics in the Autoclave to Fix the Colors.

The Chromograph.—A Solution of the Problem of Color Photography.

The Allgemeine Ingenieur-Zeitung has from the pen of F. Urban an article on this subject, which, while too long to reproduce *in extenso*, is worth a *résumé*.

Of the various attempts to produce photographs in colors, the original three-color process is inconvenient, while the modern ruled "filter plates" and "autochrome plates" require for their preparation a most unusual degree of care to get properly the thousands of small color filters of which they consist. Those who have made three-color filters know how much exactness is requisite even to make the three plates; these difficulties are repeated, however, every time. Urban undertook, therefore, to make a photographic apparatus which would make colored pictures with ordinary pan-chromatic plates, and without the use of artificial coloring materials, color filters, dyed particles, or colored lines, only by "spectral" means; the pictures showing in the apparatus itself their natural colors.

The principle of the solar spectrum is understood by all. Therein appear the seven primary colors, which may not be resolved into others, and which naturally must give a more exact reproduction of an object than the three secondary colors, that are really only a mixture of the primaries.

With the "chromograph" there is produced a field composed of many spectra so infinitely small that its individual colors are not visible; it appears, in fact, as a simple white ground. If in parts of this surface certain colors in each of the tiny spectra are covered, these parts will appear tinged with that color, or mixture of colors, which was not covered. This covering is effected in the chromograph by the black portions of a photographic plate of such character that the surface, which is composed of an infinite number of small spectra, permits everywhere the passage of only those colors which correspond to the colored object of the photograph; so that the observer sees a picture of the object in its thoroughly natural hues.

The spectra are produced by a "grating" as for a half-tone engraving, and a medium which disperses the colors; this latter may be a simple prism. The net is a photograph of a very fine and exact ruled grating. Before it reaches the sensitive plate, the optical image of the object to be photographed is refracted by the grating into lines which are further dispersed by the special color-dispersing medium into spectra; so that the plate receives a picture composed of an infinite number of tiny spectra. If the apparatus is directed against a white field, these spectra will be perfect; if, however, the object photographed is colored, the picture on the plate will contain only the colors of that object. Those portions of the small spectra which were of other colors will be dark. The microscope shows that portions of the picture corresponding to the white parts of the object photographed, are really composed of thousands of small spectra; but the naked eye sees only a white field.

If the picture is developed, all parts on which the light acted will be opaque, the others transparent, as with an ordinary negative. The positive from the negative will be reversed in the matter of light and shade. Placing this positive in the apparatus in exactly the same place as the original negative, and directing the apparatus against a white surface, one sees instead of white fields composed of an infinite number of microscopic spectra, a picture which is influenced by the intermediate positive with its dark places. The small spectra will be covered on those places, which are dark in the positive; and in each of the small spectra those colors will be allowed to pass through in the same degree as shown by the object photographed. Where there were green lines on the original plate, the spectral green will be allowed to pass through; so that the unaided eye will see a picture of the object photographed, in natural colors.

Up to some years ago there were known only plates which were almost insensitive to green, yellow and red; and with such plates one could hardly photograph objects which contained these colors. Deep red showed black. In 1873 Vogel discovered that these plates could be made more sensitive for green, yellow, and red, by dipping them in very dilute solutions of certain aniline dyes. Eder made a study of the laws of action of these dyes, and nowadays only such plates are used for colored objects. They are called isochromatic, orthochromatic, and panchromatic. For use in the chromograph, such plates are used, in connection with a yellow screen, which corrects their unequal sensibility, by weakening those colors (principally blue) for which they are too sensitive.

Urban, however, does not first make a negative, as in black-and-white photography, but makes a positive by arresting development, washing the plate, and bringing it to the light. In this way the picture is in a certain sense copied on itself. The silver precipitate of the first development is dissolved, and it is again developed and fixed. The result is a strong enough positive.

Naturally, a paper picture can be made in the same way, as for instance, by pinatypy (a process something like hektography) or by means of the three-color process. By inserting color filters one after the other, there may be made from the plates the separate pictures for the three-color or multicolor process; but outside of the apparatus there may be used gratings with black lines, copies of the filter, with which the different colors may be covered. There are also special papers for giving from colored transparent views copies true to them in color—for instance, the Uto paper, known in the trade. On such paper one can copy the pictures outside of the apparatus, replacing the spectra by a copy thereof on a film (for instance, made by pinatypy) between the plate and the paper for color copies.

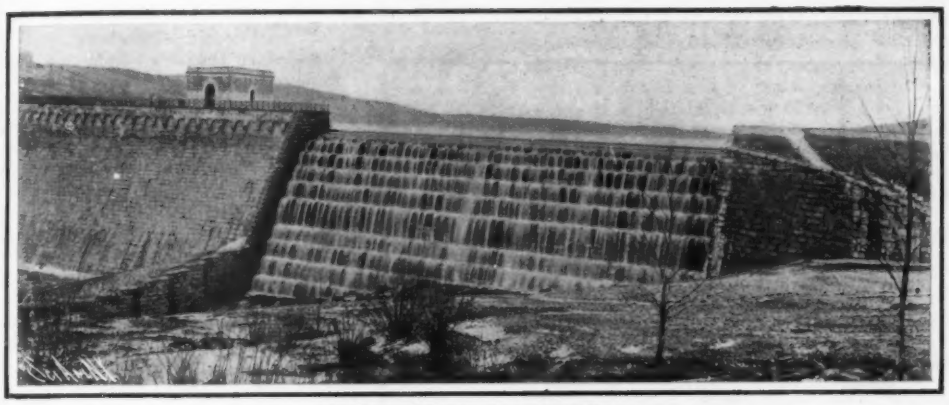
MAXIMUM ECONOMICAL STORAGE CAPACITY OF THE CROTON WATERSHED.

The Croton watershed, from which New York city derives its water supply, is located to the east of the Hudson River, and about 35 miles north from the city. The area included, as shown in the accompanying map, is described as of a rolling character, largely agricultural and grazing. The greatest elevation rises to about 1,300 feet above sea level; and more than 90 per cent of the area lies between 1,000 and 200 feet above sea level, the latter being the elevation of the spillway of the new Croton Dam. Within the watershed there is no very large area of forests, and no large towns. Above the Croton Dam, which is located on the Croton River at about 2½ miles from the point where the latter discharges into the Hudson River, the total area of the watershed is 360.4 square miles.

Because of the height and cost of the dam and the difficulties of construction, it was out of the question to secure sufficient storage capacity by the construction of a single great dam and reservoir, and consequently, nine separate reservoirs have been built from time to time and six natural ponds have been improved for purposes of storage. Recently, a large reservoir known as the Cross River, holding 10,308,000,000 gallons, has been completed, and another, to be known as the Croton Falls reservoir, is being constructed, whose capacity will be over 14 billion gallons. All of these reservoirs are shown in the accompanying map. The more important are the Amawalk, impounding nearly 7 billion gallons; the West Branch or Carmel Reservoir, with a capacity of 10 billion gallons; the Titicus, of 7 billion gallons, and the New Croton Reservoir, which impounds slightly under 30 billion gallons. The total available capacity of these reservoirs and ponds when the Croton Falls Reservoir is completed, will be 104,530,000,000 gallons. It is estimated by the engineers that the system as thus built up can just furnish 336 million gallons of water daily through a series of dry years no worse than has occurred during the past forty years, during which records have been kept.

Middle Branch Reservoir. Capacity, 4,000,000,000 Gallons.

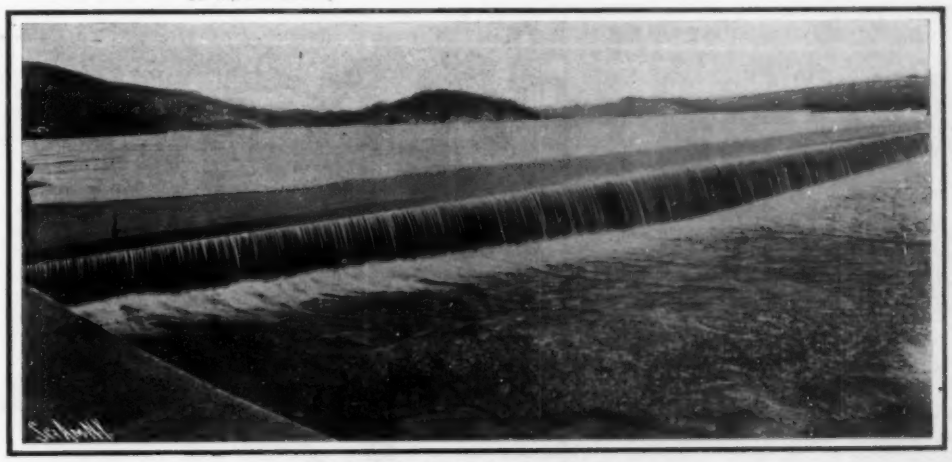
Carmel Spillway. Capacity, 10,070,000,000 Gallons.



One and one-half inches flowing over spillway.

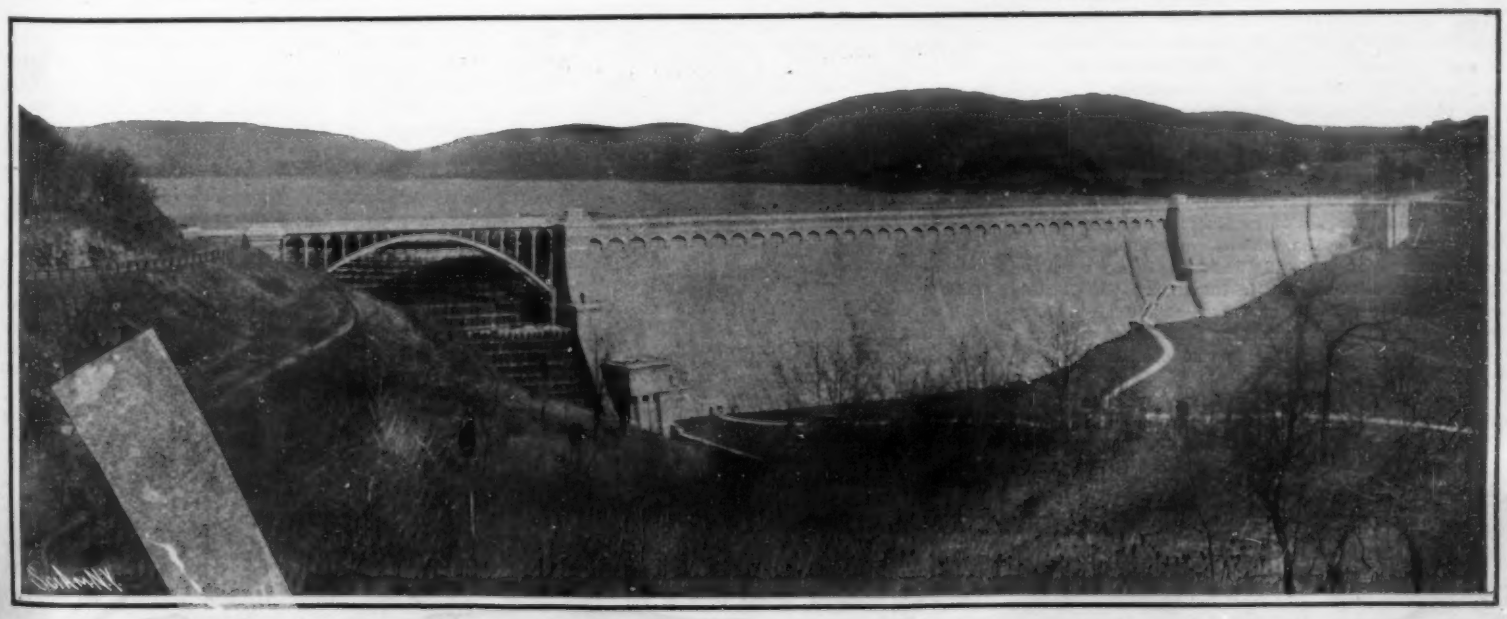
Titicus Reservoir. Capacity, 7,167,000,000 Gallons.

Two or three years ago Alfred D. Flinn, M.Am.Soc. C.E., made a diagram for the Aqueduct Commission, showing the actual annual flow of the Croton River, from which it appeared that the 36 years from 1869 to 1904 were divided into two 18-year periods, the first of which was strikingly drier than the second, as shown by the fact that the annual average flow of the Croton River for the first eighteen years was 127 billion gallons, and for the second 165 billion gallons. Moreover, a similar wide variation is liable to appear in the course of a single year, as is shown by the records of 1907. During the first eight months the rainfall was only 28.1 inches, or 5 inches below the average. About the middle of September a heavy rainfall occurred which rapidly filled the reservoir, and was so heavy that by the end of the year the to-



Two inches of water flowing over spillway.

Sodom Reservoir. Capacity, 5,243,000,000 Gallons.



The Croton Dam, Capacity About 80,000,000,000 Gallons; the Reservoir Full and Water Flowing Over the Spillway.

MAXIMUM ECONOMICAL STORAGE CAPACITY OF CROTON WATERSHED.

tal precipitation had risen to 59.6 inches, a figure which has been exceeded but twice during the past forty years.

In November of last year not only were all the upper reservoirs filled, but the water rose to the crest of the great 1,000-foot spillway of the Croton Dam, and began to flow over. The overflow increased in capacity until it reached a depth for the whole length of the spillway of one foot. It has continued up to the present time with practically no intermission. At the time the accompanying photographs were taken there was about 1 inch of water passing over; but during the heavy rainfall of two weeks ago this was again increased to a depth of about 6 inches.

Now, in view of the fact that during these past winter months over 70 billion gallons of water have wasted over the Croton spillway, it was inevitable that the question would be raised in the lay mind and in the daily press as to whether it would not be possible to store this excess of water by the construction of additional reservoirs throughout the watershed, and so obviate the necessity of going into the Catskills and building another system of storage and supply at a cost of $161,000,000.

The subject has been carefully investigated by Mr. Flinn, who found that to prevent any water wasting over the spillway of the new Croton Dam during a period of forty years, similar to those from 1868 to 1907, it would be necessary to build storage reservoirs sufficient to hold 409 billion gallons. The average daily supply that could be sent down through the aqueducts to the city under such conditions would be 383 million gallons. But this is only 47 million gallons daily more than will be available when the Croton Falls reservoir has been completed, and to build the necessary reservoirs to secure this amount would call for the expenditure of $153,000,000. Now, if we compare this with the Catskill system of supply now under construction, we find that it will be possible to bring 500 million gallons daily into New York city for a total first cost of $161,000,000. Evidently then, an attempt to secure any considerable increase in the supply of water from the Croton watershed would be a costly and very extravagant procedure. At the same time there are certain locations within the watershed where a considerable amount of additional water could be stored at a reasonable cost; and, in view of the fact that the completion of the Catskill supply, or even of a portion of it, cannot take place for several years, the policy of building some additional storage reservoirs in the Croton watershed becomes a matter for careful consideration.

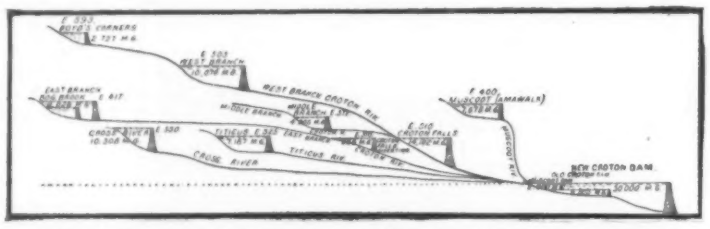
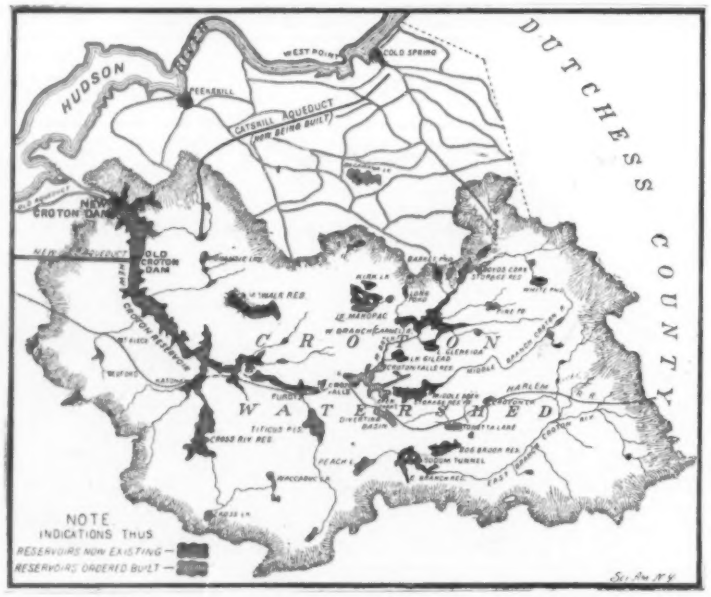


DIAGRAM SHOWING RELATIVE ELEVATIONS AND CAPACITIES OF CROTON RESERVOIRS.



PLAN OF THE CROTON WATERSHED, SHOWING RELATIVE POSITIONS OF THE RESERVOIRS.

Needles, Pins, and Hooks and Eyes.

According to the census of 1905, 46 establishments made a specialty of manufacturing one or more varieties of needles, pins, or hooks and eyes. These establishments reported a capital of $5,331,939, 3,965 wage-earners, wages amounting to $1,595,923, and products valued at $4,750,589. Almost equal numbers of men and women were engaged in this industry, the numbers being 1,862 and 1,860, respectively.

In addition a number of factories produced quantities of these articles without specializing on them. The total output amounted to 1,766,073 gross of needles, valued at $1,518,411, and pins valued at $2,632,656, a total value of $4,151,067 for both classes of products.

The leading variety of needles manufactured was sewing machine needles, with a production of 776,542 gross, valued at $600,046. Latch knitting machine needles were next in rank in importance, the 310,846 gross of such needles being valued at $422,655. More spring knitting machine needles (332,788 gross) were manufactured, but their value was considerably less ($118,223).

Large quantities of each variety of pins were produced—132,632,232 gross of common or toilet pins, 2,550,650 gross of safety pins, and 1,704,900 gross of hairpins. The values of these varieties were $1,129,006, $829,286, and $109,245, respectively.

All other products, including hooks and eyes, were valued at $1,542,028.

Zinc mining in Mexico has become important only in the last three years. The most important zinc deposits are near Monterey. At Calera there is a large amount of mixed sulphide ore, while the Tiro General in San Luis Potosi is also producing zinc ore.

Cellit: An Incombustible Celluloid.

At the last meeting of the Düsseldorf Scientific Society, Dr. A. Eichengrün described and exhibited an incombustible substance of the nature of celluloid which he has produced and named cellit, and gave a review of earlier attempts to diminish the inflammability of celluloid. About ten years ago the problem appeared to have been solved by the discovery of the acetyl-celluloses, but these substances, which were made from hydro-cellulose, were too soft for practical use. Several years ago Dr. Eichengrün succeeded in producing directly from cotton wool an acetyl-cellulose of much firmer consistency, but the new product (triacetyl-cellulose) has found no technical application because it does not, like guncotton (nitrocellulose) form a plastic mixture or "solid solution" with camphor, but is soluble only in chloroform, which is very injurious to the health of the workers. Recently, however, the experimenter obtained a new acetyl-cellulose which forms with camphor a plastic and easily worked mass and also dissolves in acetic ether and other harmless solvents. It is even possible to replace the camphor by various substitutes and in this way different varieties of cellit can be produced, hard like celluloid, soft like leather, and even extensible like India rubber. All of these varieties are perfectly transparent, unaffected by water, free from brittleness and, above all, incombustible. Some sorts cannot be ignited at all and though other sorts may be kindled, the flame quickly dies out. In cellit, therefore, we have a new material which combines the good qualities of glass, gelatine, celluloid, leather, and India rubber, and which may advantageously be substituted for these materials for many purposes. But cellit will also find entirely novel and peculiar fields of usefulness, as it is the only known substance which is at once as transparent as glass and as flexible as cloth.

The lecturer exhibited a great variety of colored and colorless sheets of cellit, of every grade of elasticity, some of which were stamped with fine line patterns or with deep angular depressions which produced the effect of cut glass. Of still greater interest were papers and fabrics coated with cellit and stamped to imitate enamel and leather and to produce various quite novel effects. Among these products were black and colored "patent leathers" and materials similar to oil cloth and enameled cloth, except that the patterns, instead of being printed in opaque colors, were woven in the underlying fabric and yet were clearly visible through the transparent coating of cellit. Electrical wires in which the ordinary silk insulation was replaced by a much cheaper, thinner and more ornamental layer of cellit, were also shown.

The new material, in the form of very thin transparent sheets, appears to be particularly well adapted to the manufacture of ornamental water-tight and air-tight packages for perfumes, bonbons and the like, and to bookbinding, in which the immunity of cellited paper from injury by dampness or handling is peculiarly valuable. Cellit may also be employed to advantage in the manufacture of objects which are now made of gelatine films, which are easily broken and injured by water, or of gutta percha, and the small ornamental objects for which celluloid is employed. The high price of cellit may prevent its substitution for celluloid in all cases, but it will probably take the place of celluloid for many purposes, especially as the technical difficulties of making hollow blown objects like balls, dolls' heads, etc., of cellit have recently been surmounted. All the above-named applications have been developed so far that factory work on a large scale is now possible, and in some cases it has already commenced.

An important field of application, in which the incombustibility of cellit is of immense importance, is found in the manufacture of kinematograph films.

In tests made at the Liesegang works cellit films were entirely unaffected by ten minutes' exposure to a beam of light of sufficient intensity to cause celluloid films to burst into flame in three seconds, the film being motionless in both cases. Hence the introduction of cellit films will remove the principal cause of fire in moving picture theaters. It is expected that the machinery required for the manufacture of cellit kinematograph films on a large scale will be completed in a few weeks.—Translated for the Scientific American from the Düsseldorf General-Anzeiger.

The Destructive Pest of the Italian Olive Oil Plant.

The cultivation of olive oil which constitutes an important industry of Italy is suffering severely from the ravages of a virulent pest—the keiroun or oil worm. In the northern parts of the country the oil yield has been in great demand owing to its low acidity and almost complete lack of smell. Up-to-date methods of gathering and grinding the olives together with improved preserving processes are being adopted with the result that increased demands for the product from various parts of the world have arisen, but the poorness of the crops has considerably depreciated the supply with the result that prices have increased. Outside of Italy the greatest bulk is purchased by Great Britain, but for the past few years exporters have been draining upon their reserves and as these are now very low the oil promises to become a luxury unless some expeditious means of combating the havoc wrought by the oil worm can be discovered.

The government has granted a subvention for investigating the disease and the discovery of an efficient remedy. The oil-worm when in the fly stage infests the young fruit and inflicts widespread injury. Fairly satisfactory results have been secured by the utilization of a *dachicida* or larva-killer invented by Mr. de Cillis. This is a solution composed of molasses 65 parts, honey 31 parts, glycerine and arseniate of soda each 2 parts. This is mixed with water in the proportion of 1 part to 9 parts of water and sprayed on the trees by means of a hand pump, the application being made from four to six times during the season. That it is efficacious to a certain degree is borne out by experiment, for areas so treated have shown only from ten to twenty per cent of olives attacked, while in adjoining districts not so sprayed the damage has aggregated as much as 80 per cent of the crop. The remedy, however, is not of an exterminating nature, while moreover its application is somewhat restricted, especially in those places where the trees grow to a height of 60 feet. In order to bring about the complete extermination of the pest it is urged that the government should pass a measure ordaining the collection of the crop by the end of March at latest. By such means the fly would be starved out of existence. Observation has shown that the pest always attains alarming proportions after a plentiful crop when harvesting is perforcedly delayed, the fruit remaining on some of the trees as late as May or June, when in other districts the fruit is just commencing to form. As a result the fly forsakes the older trees for the young, tender fruit, while the mild weather which prevails at that period favors its rapid multiplication. By legislating the harvesting of a crop not later than March, when other trees are only just sending forth the blossoms, the fly unable to obtain any subsistence during the interregnum, would be starved to death.

Correspondence.

Casting Out the Nines.

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Albert R. Gallatin in the SCIENTIFIC AMERICAN for May 2, page 311, asks for an explanation of the "remarkable property" of numbers which is known as casting out the nines. Allow me to offer the following.

Adding 9 to any number (in decimal system) does not increase the sum of the digits, as it subtracts unity from one place and adds the same to the next higher place.

Multiplication is rapid addition.

Any number may be put in the form $9a + b$, where a or b may be zero, a any positive integer, and b any less than 9. Thus b is the residue on casting out the nines from the number, for reasons above.

The product of any two numbers, $9a + b$ and $9c + d$, is $81ac + 9(bc + ad) + bd$, whose residue on casting out the nines, because of the two statements given first, is bd, which is the product of the two residues of the numbers multiplied. Manifestly this holds for the product of any number of numbers, and after the nines are cast out of the product bd as well.

Salem, Va., May 8, 1908. CHARLES C. GROVE.

More Curious Facts About Numbers.

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed with great pleasure the articles printed under "Peculiar Properties of Numbers" on the correspondence page of the SCIENTIFIC AMERICAN, and would like to add one or two which I have noticed.

I. Writing the cubes of the numbers 1 to 10, 11 to 20, or any similar series of cubes, we find the last figures of the cubes are the ten digits in the order 1, 8, 7, 4, 5, 6, 3, 2, 9, 0; and writing 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 under them, we find that 2, 3, 7, and 8 are in their reverse order, while the others are in their proper positions.

II. The fifth power of any number has for its last digit the last digit of the number, for we have 1, 32, 243, 1,024, 3,125, 7,776, 16,807, 31,968, 59,049, 100,000.

III. If the coefficients of $(x + y)$ are added, with the units figure of each coefficient in the place corresponding to the term, we have the nth power of 11 for a result. Thus, taking $(x + y)^8$, we have

```
      1
      8
     28
     56
     70
     56
     28
      8
      1
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214358881
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which equals 11^8. Or $(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$. We have $1,331 = 11^3$.

IV. A table of any power of successive numbers can be written by addition; for instance, the squares of which you have already spoken. Each difference is 2 greater than the latter, even to the minus quantities, for we have: $(-3)^2 = 9$, $-5 = 4$, $(-2)^2$, $-3 = 1$, $(-1)^2$, $-1 = 0$, $0^2 + 1 = 1$, $1^2 + 3 = 4$, $2^2 + 5 = 9$, 3^2, etc. Also in the cubes, but in this case two additions must be performed. Starting with $1 - 0$ and adding them we have 1; add 6 to 1, giving 7; then add this to 1, we have 8; add 12 to 7, we have 19; add this to 8, we have 27; or, in tabular form,

		0
		1
		—
	1	1
	6	7
	—	—
6	7	8
6	12	19
—	—	—
12	19	27
6	18	37
—	—	—
18	37	64
6	24	61
—	—	—
24	61	125 etc.

The difference in the first column is constant, being 6, therefore the first column may be omitted, the difference in the second column being taken as six greater each time.

So with any power, the necessary additions for each term being one less than the exponent.

Also the constant difference in the first column of each for N^n is $n\,|$; thus for the square it is $1.2 = 2$; for the cube, $1.2.3 = 6$; for the fourth power, $1.2.3.4 = 24$, and so on.

I have also known for quite a while that $1 + 2 + 3 + \dots + (n-1) + n = \frac{n^2 + n}{2}$ and use it quite often in counting things placed in triangles, as for instance dry batteries tied up in a triangle. I usually use it in the form of $\left(\frac{n}{2}\right) n + 1$ when n is even, and $\left(\frac{n+1}{2}\right) n$ when n is odd. Thus for pool balls we would have $5 \times \frac{6}{2} = 5 \times 3 = 15$.

A short cut for multiplying by 11 is to set down the last figure, add it to the next last, and set that down, carrying if necessary, add the next last to its predecessor (and 1 if carried) and set it down, and so back to the first figure, which set down. Thus to multiply 234,527 by 11 we have 7; $7 + 2 = 9$; $2 + 5 = 7$; $4 + 5 = 9$; $3 + 4 = 7$; $2 + 3 = 5$; 2: 2,579,797. Or $5,184 \times 11$; 4; $8 + 4 = 12$, 2; $1 + 8\ (+1) = 10$, 0; $5 + 1\ (+1) = 7$; 5: 57,024.

Detroit, Mich., May 3, 1908. BERNHARD DAWSON.

CONTROL BY SOUND WAVES.

BY R. G. SKERRETT.

Mr. John Gardner, an English engineer and well-known inventor, has recently perfected a system of distant control by means of sound waves propagated subaqueously. Mr. Gardner's initial aim was to secure wireless control for a submarine vessel of his own design—some means of control not easily susceptible of "interference" on the part of an enemy.

From the very beginning, he realized the difficulties of effecting his purpose by means of Hertzian waves, and while he did reduce the chances of "interference" to a large extent, still there was risk enough remaining to discredit control by aerial wireless. Mr. Gardner then turned his attention to subaqueous transmission of sound waves, and in order to obviate the chance of "interference" by the waves generated by existing systems of submarine sound signaling, Mr. Gardner based his control upon a tonal impulse the key of

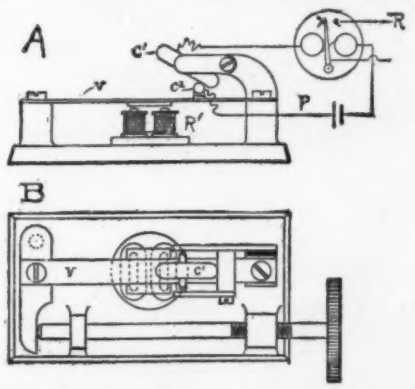


Fig. A.—V is a metallic resonator or vibrator which can be tuned to a range of several keys. P. Primary circuit controlled by the resistance of the microphone carbons C1 and C2, which in turn controls the position of the tongue which makes and breaks the relay circuit R. R' is a second relay circuit which can be installed for the control of other functions.

Fig. B.—Shows in plan the arrangement of the tension screw for varying the pitch of the resonator V, and also the manner in which the upper carbon of the microphone is held.

which could be varied to suit any condition; and to make "interference" still less likely he adopted a bi-tonal or multi-tonal receiver which could be made responsive only to the simultaneous sounding of all of the required notes and these of a definite endurance and sequence.

Mr. Gardner has in his laboratory an apparatus designed to function upon this tonal system, and when the voice is properly pitched to accord with the receiver, it is possible to control the various mechanical movements of a small submarine model. Should the voice be ever so little out of key, the receiving apparatus is absolutely unresponsive. While the receiver may vibrate to some extent by reason of other sounds or tones of other keys, still the proper amplification of the receiving vibrator is not produced which alone can bring about the electrical disturbance necessary to stimulate the relay circuit actuating the various mechanical operations of the model.

As most of us know, each musical note has its own individuality, which is measured or marked by the number of vibrations per second necessary to produce that tone in a vibratory substance. Mr. Gardner's receiving apparatus consists primarily of a metallic reed fastened at both ends and so arranged that a tension screw can vary its pitch. Upon this reed or resonator is placed near one of the nodal points one of two small carbons of a microphone. This carbon is of such weight as not to interfere with the free vibration of the metallic strip. A second carbon pencil is suspended over the tape and so pivoted that it rests lightly upon the first carbon pencil in such fashion as to preserve contact, yet without "dampening" the free movement of the sensitive resonator. These carbon pencils form the variable resistance in the circuit controlling the opening and closing of a second and more powerful relay circuit. When the resonator is undisturbed or agitated by an improper note, the carbon pencils are in sufficient contact to hold the tongue controlling the relay circuit in a position preventing the closing of the latter circuit. When the proper note arrives and the resonator is amplified to the proper degree, the microphone contacts are so disturbed as to destroy the balance of the circuit and at once the relay tongue swings over and closes the latter circuit and sets in motion the various mechanical movements which a prearranged succession of impulses is designed to control.

Although the initial aim of Mr. Gardner's system was to give him the power of directing the movements of a submarine vessel from a distance, still the principle has a wide field of application. By the same means it would be thoroughly feasible to control the detonation of submarine mines. These mines could be planted in groups, and each group designed to be exploded by the sounding of a particular note, a small resonator being placed in the circuit of the firing battery installed in each mine. When the required note was sounded subaqueously by the observer noting the enemy's approach, that group of mines responsive to that special tone could be exploded. A system of this sort would do away with much of the cumbersome attachments and cables now a feature, and an expensive one, in all installations of observation mines. In addition to this, gas-illuminated buoys could be lighted and extinguished by a similar system of control; and there are a great many other applications possible to this method of wireless direction.

As an amplification or improvement upon the present system of submarine sound signaling, Mr. Gardner's invention promises valuable results. It will eliminate the personal equation and make the reception of the warning signals automatic. The acuteness of hearing of the individual will be eliminated, and the error due to the difference in keenness of hearing between the ears of a single person will be entirely removed. Submarine sound signals have already been successfully transmitted over a distance of quite fourteen miles—sound traveling four times farther under water than through the air; and this projecting of sound can probably be sent still farther by means of sufficiently powerful generators. By the Gardner system, the faintest sound wave of the proper key would be sufficient to agitate the resonator and to cause the closing of a relay circuit of power enough to move indices either in the chart house or on the bridge, and by ringing a small bell give warning of approach to the range of the admonitory signal. These tell-tales would be two in number—one giving readings for the port bow and the other for the starboard bow. By means of a resistance in the circuit, it would be possible to give perhaps an approximate indication of the distance off and the direction of the source of the sound wave. In this manner, the navigator would be automatically advised upon approaching the radius of impulse or danger zone, and by swinging his vessel's head so as to bring the reading of the tell-tales in unison, he would have a visual indication that his ship was pointed directly toward the source of sound. If each of these originating signals had a definite key, the receivers on the ship could be adjusted so as to respond to each in turn—this would apply particularly when following up the coast; and should it be desirable to make the receivers alive only to some one of a succession of such signals, it can be done just as readily.

By using a two-tone or three-tone receiver, it is possible to make still more certain security against "interference" or mistake; and a little deliberation will show that a system of this sort is susceptible of well-nigh unlimited expansion. There is no reason why sound control in this manner could not be used aerially; but atmospheric conditions would necessarily limit the radius of its effective application.

The Quantity of Radium in the Laboratories of the World.

Madame Curie possesses 15 milligrammes of radium, Prof. Bordas 10, M. Becquerel 10, Sir William Ramsay 20, Sir William Crookes 20, Prof. d'Arsonval 20, and Thomas A. Edison 20 milligrammes. About 20 milligrammes more are in the possession of other professors. All this is in the form of pure or nearly pure radium and its salts, and the entire amount is 135 milligrammes, or about 2 grains troy.

Commercial low-grade radium is distributed among a great many hands and its strength is very variable. Hence exact statistics are not obtainable, but it is estimated that the entire amount of commercial radium contains less pure radium than the quantity in the possession of scientists, as stated above.

To these supplies must be added the comparatively enormous quantity of 3 grammes of radium which Profs. Exner and Wien have lately extracted from half a ton of Joachimsthal pitchblende, the value of which is estimated at $80,000. One gramme of this is to be lent to Sir William Ramsay for experiments on radium emanation.

FOREST DESTRUCTION AND THE EROSION OF ARABLE LANDS.

BY DAY ALLEN WILLEY.

The work of the elements in eroding or eating away the surface of the United States affords a study for the scientists which is of extreme interest and importance. So many are the causes of erosion and so varied are its effects, however, that a series of volumes would be needed to describe the effect of air and water merely on the different soils, in the various climates, and at the various altitudes.

Perhaps the most familiar effects of earth erosion are in the West, in such regions as the Arizona desert, where the crumbling away of the surface has revealed the petrified forests. The remarkable formation in the Bad Lands of Dakota and Nebraska and the picturesqueness of the famous Garden of the Gods in Colorado are due almost entirely to the wearing away of the softer formation exposing the curious shapes formed by the more solid composition. Much of this erosion is due to the extremely dry climate and high temperature, which have caused the earth to become remarkably friable. Here and there can also be seen the effect of water upon the soil, but a really wonderful result of the power of water is in what is now the famous Salton Sink, into which the detritus from millions of acres of the States of Arizona and Utah has been carried and deposited by the action of the Colorado River, the original surface of the sink being covered in some spots to a depth of no less than 200 feet.

Erosion caused by a river or creek, however, is seldom beneficial. In the case of the Colorado, the material carried down in flood contains so many fertile ingredients that it has reclaimed a large area of the Southwestern desert, making it fit for cultivation by irrigation. In this respect the conditions resemble the annual inundation of the valley of the Nile with its renewal of the fertility of the soil.

In many other portions of the United States, however, the result of erosion by water has brought literal destruction to very large areas of farm land and of territory available for agriculture by reason of its advantages of climate and soil. In spite of the enormous extent of cultivated lands in the various portions of the country and the many tracts which can be made available by the farmer in the East as well as the West, this destruction has already assumed such large proportions that it has seriously affected our most important industry. While evidences of the injury done by erosion can be found in New England and in many parts of the Middle States, possibly the Southern States present the most notable illustrations. This is due to several conditions, such as the topography, the character of the soil, the size and number of the streams and the volume of water which they carry, especially in the flood season. A considerable area of the South is composed of the flat, level land adjoining the seacoast. The descent of the rivers from the mountains where they have their source to the coastal plains is so abrupt that experts of the Geological Survey who have been investigating the Appalachian region estimate that nearly 3,000,000 horse-power could be secured from the principal water courses—more than enough to operate all of the industries of the South at the present time.

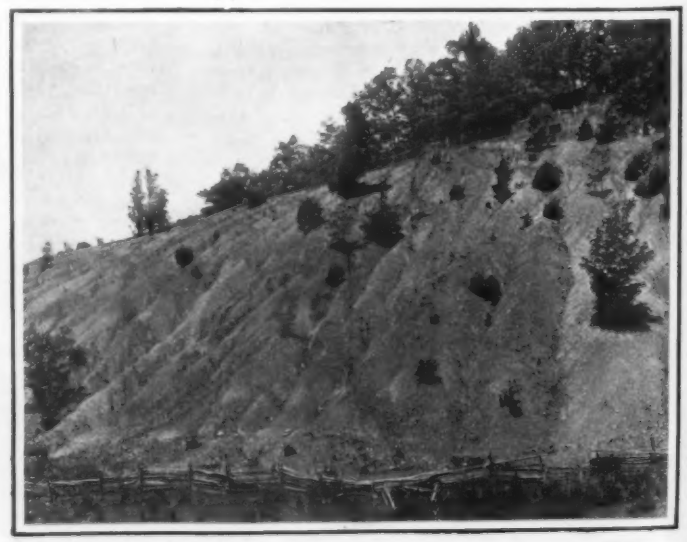
Brush Dams Which Are Now Being Introduced in the West to Hold Back the Mountain Torrents.

This figure illustrates the volume and force of the water in the Southern rivers. During the flood season, when the rivers are swollen by the melting snows in the mountains or by heavy rains, and the flow of water is many times greater than at other periods, some of the streams become literal torrents and carry down their course an enormous amount of sand, gravel, and other detritus, much of which is held in solution. Unfortunately this material is unlike what is carried by the flood waters of the Colorado and the Nile; for it usually covers the land to such a depth that the soil is worthless for agricultural purposes. This distribution of alluvial material is one of the most serious destructive effects of erosion. Every year large areas of the valleys in the Piedmont section, as well as of the lands of the coastal plain, are inundated by the high waters, and this deposit left upon their surface. The direct erosion caused by the flood water, however, is another great injury to agriculture. The soil of the Piedmont region consists largely of clay and loam, the upper stratum of which is so soft and loose that the contact of water causes it to dissolve just as a pile of sand will be disintegrated by a small jet of liquid. It is this quality of soil which is noted for its crop production. Upon the "red lands," as they are called, of the Carolinas and Georgia is raised a large proportion of the cotton crop, some of the planters averaging nearly two bales of cotton to the acre. This land is also adapted for the growing of fruit, as is shown by the great peach orchards in the red lands of central Georgia. Much of it is included in the older plantations which have been cultivated for over a half century. It is in this country, however, that erosion from water has done great injury; for many of the plantations are situated in the foothill country where the land is sufficiently rolling to permit a rapid flow of water.

The erosion even of a small rivulet is of such an extent as to seem almost incredible. The writer has measured ravines and gullies in the plantation districts of South Carolina which were actually 50 feet in depth, yet only two or three feet wide at the top. The drainage water cut through the soft surface like a knife, and with no hard clay or rock to stop its course, had eaten its way into the earth. With such a formation, it is not strange that one can see fields of 50 acres or more which have been abandoned because so creviced by the water. But even greater damage has been done to plantation and other bottom lands in the valleys through which flow the mountain rivers. Such may be the force of the flood torrent that it will carry away the entire earth crust, washing it down to the rock itself. As these bottom farms are usually extremely fertile and produce large crops of corn and cotton, the loss to the farmer is very great.

The engineering work which has been done in Europe and other countries shows that much of this destruction of farm land in the United States can be avoided, if only methods are adopted to confine or limit the flow of water. The fact is that America is

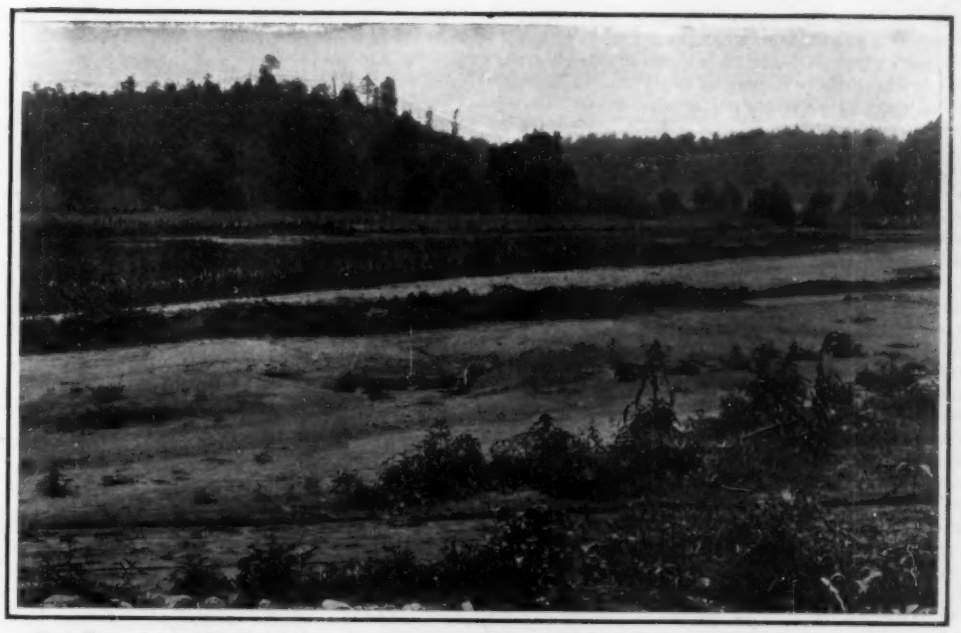
A Hill, Once Wooded, from Which the Earth Has Been Washed by Storms Because It Was Unprotected.



An Example of the Destruction of Farmland by Erosion. A Field Washed Out, Caused by Failure to Ditch.

FOREST DESTRUCTION AND THE EROSION OF ARABLE LANDS.

very far behind such countries as Switzerland, Italy, and France, where systems have been employed which have averted much of the erosion that formerly prevailed in the mountainous sections. The investigations by the experts of the Geological Survey as well as the United States Forest Service proves beyond question that the floods are due largely to the indiscriminate cutting of timber along the head waters of the southern streams. It is needless to say that the industry has been so wasteful that entire tracts of woodland forming the watersheds of some of the principal southern rivers have been stripped of their trees, so that the country is practically denuded of forest growth. The result of this is that the bare watersheds do not hold the rainfall and melted snow, the water flowing directly into the river channels and thus forming floods. The forest cover, as it might be called, really acts like an enormous sponge, absorbing the precipitation of moisture, which gradually drains off. The work of the timberman, however, as already stated, has so stripped many of the watersheds that this sponge has been destroyed. An investigation of floods in North and South Carolina shows that the worst ones have been in watercourses from which the woodland has been thus removed. The history of the Southern States also proves that the connection between great floods and the destruction of the forests is very close; for prior to the inroads made by the timberman in the Appalachian region, the volume of water coming down the rivers during the so-called



How Farm Lands Are Ruined by Erosion Caused by Freshets. The Fertile Bottom Land Is Here Covered by Flood Sand.

Alluvial Bottom Which Has Been Destroyed by Flooding. The Small Area in the Center Shows the Condition of the Bottom Before the Floods Came.

flood season averaged far less in volume than it has in recent years.

As already intimated, the work which has been done in European countries to prevent land erosion of this character indicates what can be accomplished by the United States. As is well known, southern France is extremely mountainous. It has been stated that more than one-half of the Alpine rivers are within the borders of the French republic. It is a fact that there are nearly 1,500 brooks and mountain streams which are considered dangerous, owing to the force of their flood currents and the volume of water. They have endangered nearly a million acres of fertile land on the hillsides. Since 1860, however, the French government has been planting the lands near the shores of these streams with suitable trees, and up to the present time about 250,000 acres have been forested, with the result that the floods have been considerably checked, and a large portion of the area referred to protected from further possibility of damage. The work is considered so important, however, that about $50,000,000 will be expended before it is completed; for a half million acres of lands are to be reforested.

Switzerland affords the best object lesson. The protection of cantons and other settlements from the mountain streams has been prosecuted for over six centuries, although systematic forestry has only been in vogue about fifty years. Considering the size of the country and its population, Switzerland has accomplished really great results, for it has reforested nearly 20,000 acres of land around the sources of its mountain streams at a cost of about $1,000,000. While the conditions are such that it is impossible to prevent torrents in the flood season, the flow of water has been considerably lessened by the erection of dams and other diversion works, and thus an extensive area of cultivated country has been protected from further damage of this kind. Conditions in Italy, however, are quite similar to those in some portions of the South. One-third of its surface is unproductive at the present time, a large proportion of this consisting of sloping country, from which the earth has been washed away down to the bare rock by the unrestrained mountain rivers. It may be added that the great floods which periodically occur in China have been traced to the fact that this is one of the few countries which thus far have taken no steps to preserve or renew the forests. As a result, some of the mountain ranges, forming a source of its greater streams, have been stripped of every tree, and the precipitation from rainfall and snowfall drains directly into the water courses, thus forming the floods which have become famed for their extent and the disaster which they have produced.

This description of the situation in the Southern States can be applied to many other portions of the country where the conditions are similar. The necessity for restoring the forests at the headwaters of western rivers has been realized to such an extent that some of the most important work of the Forest Service has been to plant watersheds denuded by the timberman. This is really the main solution of the problem in the South, and unless steps are taken to regulate the rivers in the manner referred to, the tracts of worthless land caused by erosion will be greatly increased in the near future, since year by year the damage by freshet is greater throughout the Piedmont section as well as the coastal plain.

A Scene Which Shows How the Earth is Washed from the Surface Where It is Not Protected by Trees.

FOREST DESTRUCTION AND THE EROSION OF ARABLE LANDS.

EXTRACTING THE VENOM FROM A LANCEHEAD SNAKE FOR MEDICINAL USE.

About eighty years ago Dr. Constantine Hering was sent by the King of Saxony to Dutch Guiana to study the animal and vegetable life of that colony. Hering was a follower of Hahnemann, perhaps his most brilliant disciple, and the founder of homeopathic medicine in this country. From the Arrowackian Indians of Guiana, among whom he effected many a noteworthy cure, he heard blood-curdling stories of a deadly snake called "suru kuku." It had long been an idea of his that animal substances might prove just as valuable in medicine as vegetal extractives, contrary to the general belief of his time. It occurred to him that perhaps the venom of this deadly serpent might be endowed with properties of peculiar medicinal virtue. After considerable persuasion the natives were induced to capture a "suru kuku" for him. The snake that they brought to him had been crippled to the point of helplessness; yet it was alive. Of his manner of extracting the venom from the serpent, Hering has given a lively account in the Archiv fuer die Homœopathische Heilkunst, which was published in 1831 in Leipsic under the editorship of Dr. Ernest Stapf.

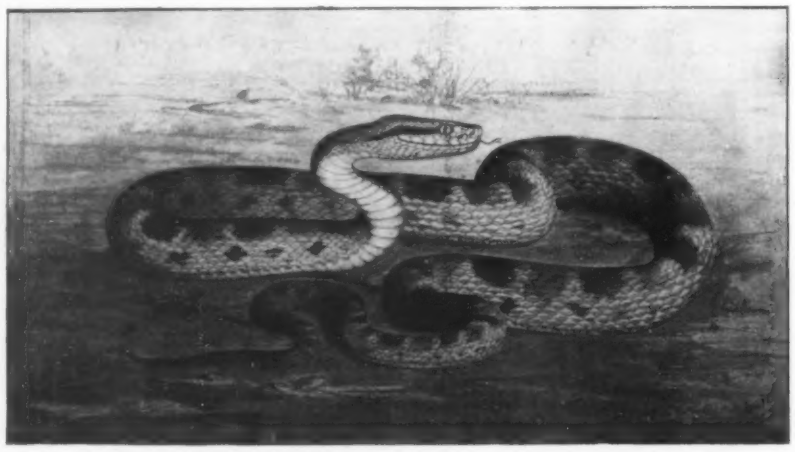
Hering's *Lachesis trigonocephalus* (the zoological name of the lancehead serpent which the Indians called "suru kuku") was ten feet long, an exceptionally large specimen when it is considered that the average length varies from five to seven feet. According to his own account, he seized the serpent, and forced open its mouth. He found that the venom could not flow because the vents were blocked by a muscular sheath. One of the natives was induced to hold the snake (much against his will) while Hering slipped a forked stick into the mouth to hold the jaws apart. He laid back the obstruction of the fang and cleansed the creature's mouth of the adhering saliva. His next step was to squeeze the poison glands. The drop of venom that flowed out he collected on a little heap of sugar of milk. By repeated squeezing he succeeded in gathering ten such drops.

This minute quantity of venom, so carefully collected, was triturated with 100 grains of sugar of milk. Every 10 grains of this mixture was again triturated with 100 grains of sugar of milk.

Like a true scientist, Hering determined to experiment on himself with the lancehead venom. In the publication previously mentioned, he gives a terse scientific account of his sensations. As a homeopathic physician he believed that disease could be cured by administering small doses of drugs that could induce the disease. By noting what ills would be induced in himself by the lancehead venom, he would know for what ills it would be available. So it happens that whatever therapeutic value lachesis venom may possess, was discovered by the very man who first took the risk of gathering it.

For eighty years that small quantity of triturated venom, collected and compounded in Dutch Guiana by one of the most remarkable physicians of his time, has been prescribed the world over by homeopathists for the treatment of septic conditions of the blood, such as pyæmia or septicæmia, erysipelas, carbuncle, gangrene, malignant scarlet fever, diphtheria, and disorders of the nervous and mental system. Although the dose prescribed is small, this sole source of triturated lachesis venom has been fast dwindling. Accordingly, a New York firm of homeopathic pharmacists, Boericke & Runyon, decided to renew the supply. A lancehead viper was imported from South America and intrusted to the New York Zoological Gardens for safe keeping. On May 10 last the venom was extracted by Mr. Raymond L. Ditmars, in whose charge the snake was placed.

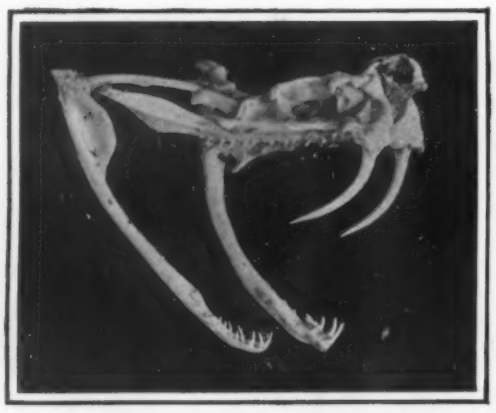
The method of gathering the new supply differed from that employed by Dr. Hering. The snake was not a cripple, and therefore exceedingly dangerous. Its head was pinned down with a forked stick, in which position the reptile was seized back of the head and at the tail by Mr. Ditmars. A glass beaker covered with a tightly-stretched membrane was presented to the snake. The viper struck at it, pierced it with its fangs, and deposited a drop of venom in the beaker. Three times the serpent was allowed to strike. In all 17.75 grains of yellowish poison were obtained. Following the method laid down by Dr. Hering so long ago, this was triturated with 99 parts of sugar of milk for every part of venom. Eventually it will be so far triturated that it will last the world for half a century. Less than one-millionth of a grain is the homeopathic dose of the poison.



The West Indian Fer-de-Lance.

Of the lancehead itself, it may be safely said that it is the most deadly serpent of the western hemisphere. A native of South America, it was introduced in the ill-fated island of Martinique to rid the plantations of rats. It did this effectively enough, but became itself a pest even more formidable. The islanders then imported the mongoose to rid themselves of the fer-de-lance, as they call the snake. Whether the mongoose succeeded in this task or not, the lachesis was all but exterminated on the island by the eruption of Mont Pelée. The serpent may be regarded as a yellow viper of the Crotalidæ family. When in pursuit of its prey, the lachesis is said to be capable of making considerable leaps. Its bite is fatal, how fatal may be gathered from the oft-quoted statement that "if by some chance you encounter in the island [of Martinique] a person who has lost an arm or a leg, you can be almost certain that you are looking at a victim of the fer-de-lance—the serpent whose venom putrefies living tissue."

The Lancehead Struck Through a Membrane and Ejected Its Venom Into a Glass Beaker.



The Jaws of the Lancehead, Showing the Poison Fangs.

How the Serpent Was Held During the Extraction of the Venom.

EXTRACTING THE VENOM FROM A LANCEHEAD SNAKE FOR MEDICINAL USE.

The twelve locomotive manufacturers in the United States and Canada built 7,362 locomotives in 1907, of which 6,477 were for use at home and 885 were exported. This is an increase of six per cent compared with 1906. These figures do not include locomotives built in shops of the railway companies. There were 330 electric locomotives and 240 compound locomotives built, as against 237 and 292 respectively in 1906.

Giffard's Process of Making Hydrogen for Balloons.

At the Aero Club's ground in the suburbs of Paris is to be set up an apparatus for making hydrogen for balloons by a new process. The idea was brought out some time ago by the French scientist Giffard and it consists of passing water vapor over red-hot iron, in which case the water decomposes and the oxygen combines with the iron, leaving the hydrogen free. To recuperate, we pass carbon monoxide gas over the oxide of iron which was formed, absorbing the oxygen and setting free the iron in the metallic state. But it required the apparatus recently invented by the Englishman, Mr. Howard Lane, in order to secure practical results for balloon work. The plant at the Aero Club consists of two gas generators, one of these being for producer gas, designed for heating purposes only, while the other gives a high-grade gas, a mixture of hydrogen and carbon monoxide. The latter is used to reduce the oxide of iron in the recuperating process and set free the metal. A boiler for producing the steam and a set of retorts to hold the iron turnings make up the rest of the essential features, besides a scrubber for purifying the resulting hydrogen. The present gas producer for the low-carbon gas, of the Wilson type, gives a mixture which contains a large amount of carbon monoxide gas and also nitrogen, with 15 per cent of hydrogen and also different hydrocarbons such as formene and ethylene, with carbonic acid gas. It is, however, sufficient to be used as a fuel. On the contrary, the second producer gives a high quality of gas which is rich in hydrogen (42 per cent) and the carbon monoxide enters into it for 37 per cent. The gas has thus a high reducing property. To carry out the process, the retorts containing the iron are heated to redness. When water vapor is projected upon the iron the hydrogen is set free and the iron is changed to magnetic oxide. In the second place, the reducing gas is sent over the oxide, freeing the metal with a resulting product of carbonic acid gas. The excess of high-grade gas which must be employed passes thence into the pipes and is mixed with the producer gas for the heating of the apparatus. The furnace which surrounds the retorts containing the iron is built of fire brick hollowed so as to give canals for the circulation of the hot air from the furnace, with a resulting economy of heat.

The present system as described is used in England and also in Russia in the aerostatic work which is in charge of General Kovanko. The resulting gas is said to contain 97 per cent hydrogen, and where coal is very abundant it can be made for $0.02 per cubic yard. In France this price will be doubled, but in any case it will be quite low. Where gas is compressed in steel cylinders for transport, the cost will be about $0.05 per cubic yard.

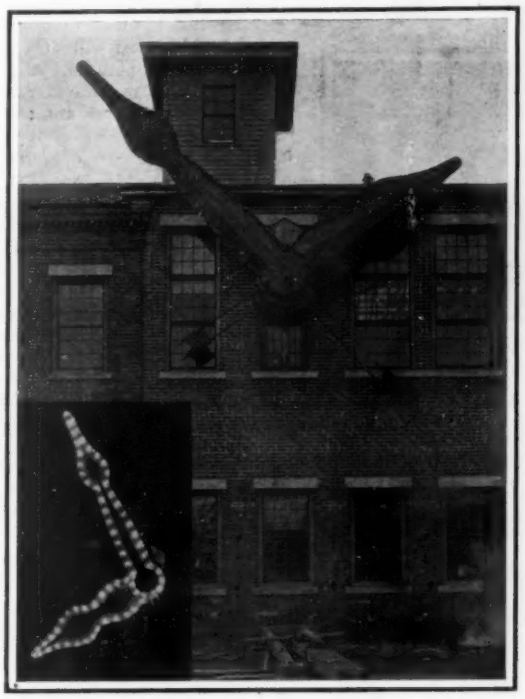
The passenger traffic through the Simplon Tunnel has fluctuated greatly and was largest in August, 1906, the third month of its operation. In that month 42,622 passengers were carried through the tunnel. The number fell to 14,545 in November of that year, and to 10,106 in the following January. The largest number in any month since has been 34,500. The freight traffic has grown rapidly but is still small. The largest in 1906 was 5,658 tons in October. For the first five months of 1907 it was about 44,000, swelled by a blockade of the Mont Cenis route. In the first year the gross earnings were some $190,000.

THE LARGEST CLOCK IN THE WORLD.

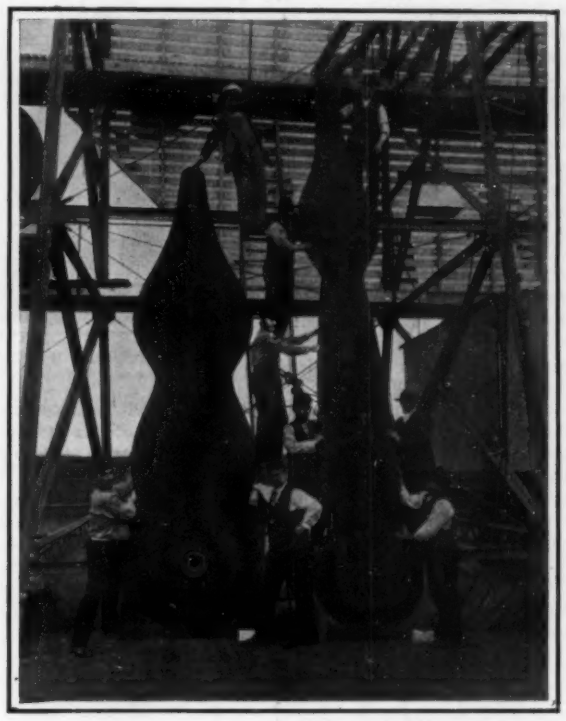
So much has been said of the great clocks of Europe, that if asked to find the largest clock in the world, one's first impulse would be to look for it among the cathedrals abroad. A number of years ago, the Philadelphia City Hall clock with its 25-foot dials wrested the laurels from London's Westminster clock, which has 22½-foot dials. Only the other day it was reported that a 25-foot dial clock would be placed in the tower of the Metropolitan Life Building; and now a new record has just been made by the clock which surmounts Colgate and Company's soap and perfume factory at Jersey City. Not only is this clock larger than any other in the world, but it has established a class of its own, because its dial area is more than twice as large as that of its nearest competitor. Possibly mention should be made of the great clock of Mechlin, Belgium, which is said to have a dial of 37 feet diameter, but it is hardly fair to make any comparison between this crude mechanism, with its single hand to mark off the hours, and the perfect timepieces of to-day. But even the Mechlin clock is surpassed by the Colgate clock. The dial of the latter measures 38 feet in diameter by day and 40 feet by night; that is, the lights which serve for the hour marks at night are set beyond the periphery of the daytime dial, and form a circle of 40 feet extreme diameter.

Some conception of the enormous proportions of this clock may be had from the accompanying photographs of the hands. The hour hand, which is shown supported by sixteen men, measures 15 feet from end to end and is 3 feet 10 inches at its greatest width, while the minute hand has an over-all dimension of 20 feet, and with its counterpoise weighs 640 pounds. Every half-minute the tip of this hand moves 11½ inches, and in the course of a day it covers a distance of more than half a mile. The hands are made of copper sheet metal, secured to a brass frame and stiffened by means of brass trusswork. The copper sheathing is painted black with a sanded surface, so that there can be no reflection of light to confuse the observer in reading the time. To lessen the wind pressure, the dial is made of 6-inch pine boards spaced three inches apart. In place of numerals, coffin-shaped strokes of black 5½ feet long are used. In large tower clocks it is found unnecessary to use the usual Roman numerals, as they cannot be read at any great distance. It is probable that few persons who have looked at the Westminster clock or that at Philadelphia are aware that the dials bear no numerals. At night the dial face will be illuminated by a ring of incandescent lamps. Each minute mark will be indicated by a 4-candle-power lamp, and at the hour mark 96-candle-power will be used in red lanterns. The hands will be outlined with electric lights, forty 4-candle-power lamps being used on the minute hand, and 34 on the hour hand. The current will be supplied to these lamps by means of carbon brushes bearing against copper contact rings.

The making of a large tower clock involves more of a problem than mere proportions. As the dial will not be incased in glass, the hands are exposed to all changes of the weather, and yet they must keep time with the precision of a chronometer. The Seth Thomas Clock Company, which is making this huge clock, guarantees that the gigantic, unwieldy hands, weighing together more than half a ton, will not vary six seconds a week from the correct time, and it is probable that even this accuracy will be far exceeded.



The Hands Illuminated.



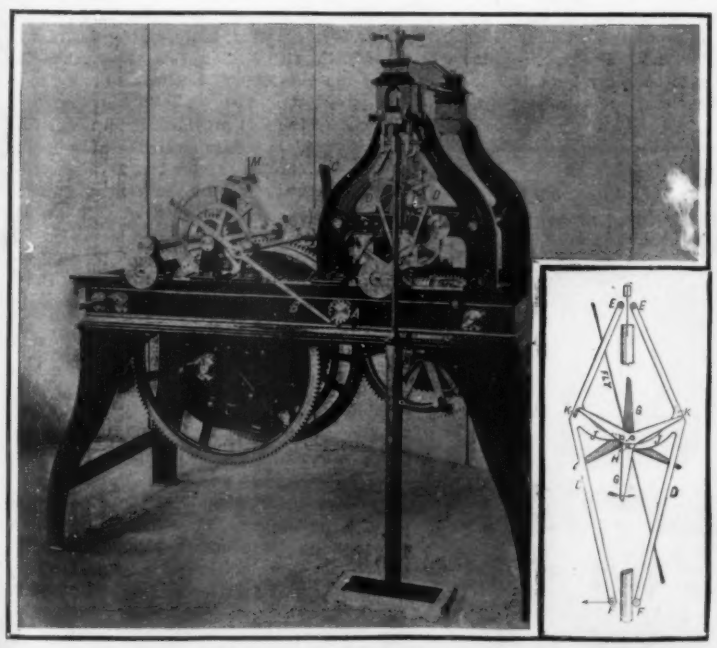
Testing the Clock at the Factory.

The Enormous Hands of the Clock, Minute Hand 20 Feet Long, Hour Hand 15 Feet Long.

The Colgate clock will be driven directly by a mechanical clock train. The clock mechanism comprises two separate movements; one, the "time train" or master clock, serves to keep accurate time, while the other, known as the remontoir train, is controlled by the time train, and acts to drive the hands of the clock.

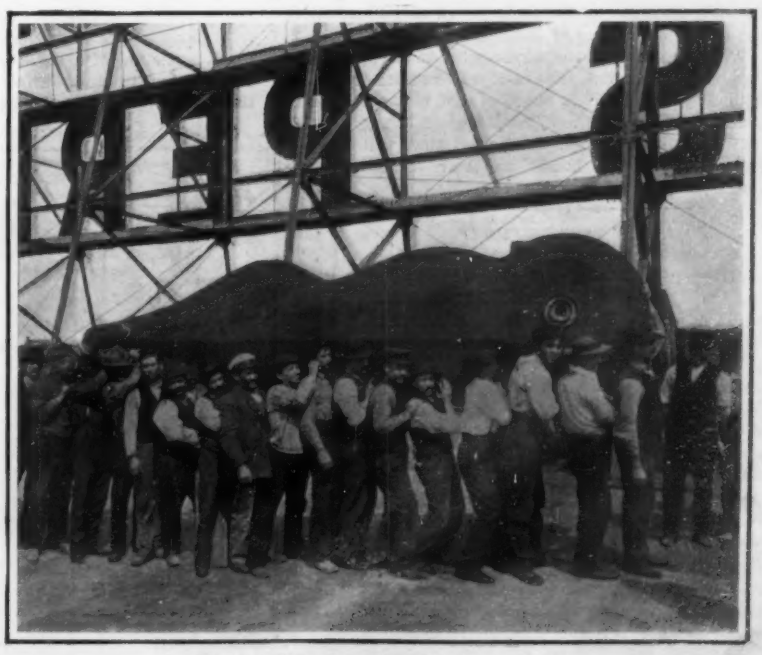
The two trains are mounted on a bed four feet long. In our illustration of the movements the time train is shown at the right, and its office is to release the remontoir train every 30 seconds. The time train rotates a crown wheel, indicated at *A*. The remontoir movement carries a lever *B*, formed with a tooth at its outer end, which is adapted to bear against the teeth of the crown wheel. As the latter revolves, the lever *B* enters between the teeth of the crown wheel, and strikes against the inner face of a tooth at the opposite side of the crown wheel. Here the lever is held in check for fifteen seconds, until the crown wheel revolves sufficiently to permit it to pass out. This releases the remontoir movement, and the lever swings around on its axis until it strikes the under side of the crown wheel again, where it is held in check as before. Every half-minute the remontoir train is thus released, and at each release the hour hand is moved half a minute. A fan *C* serves to govern the motion of the remontoir movement and prevent the lever *B* from striking the crown wheel with a sharp blow. This fan causes the lever to occupy about seven seconds in making its sweep from the release position back to the under side of the crown wheel.

The advantage in having two separate movements to drive the clock is that one acts as a relay for the other. The remontoir movement, which drives the hands directly, is operated by a weight of over 1,100 pounds. This heavy weight should be enough to overcome any jar or vibration of the hands caused by a high wind. The time train or master clock is operated by a weight of but 600 pounds, and this permits a more delicate movement. In case of accident to the



The Time and Remontoir Movements of the Clock.

Details of the Escapement Mechanism.



Sixteen Men Carrying the Enormous Hour Hand.

THE LARGEST CLOCK IN THE WORLD.

hands, if, for instance, they should be frozen fast together, or if the lights should need repairing, they could be stopped without disturbing the master clock, which would continue to keep perfect time, and after the repairs were made, the hands could be reset to correspond with the small dial of the master clock.

The form of escapement used on the Colgate clock is similar to that invented by Sir Edmund Becket for use on the famous Westminster clock, and is known as Denison's double three-legged gravity escapement. It consists of two very light arms or gravity pallets, which alternately give the pendulum a gentle push and thus keep it swinging. The arms are partly withdrawn before the advancing pendulum by the clock train, and when overtaken by the pendulum they are released, and falling with the pendulum on the return stroke serve to give the latter the necessary impulse. The accompanying diagram will give a clear idea of the operation of this escapement. The two gravity arms are indicated at *D*, suspended on separate pivots *E*, and fitted with roller beat pins *F* at their lower ends. The clock movement operates two locking plates *G*, each formed with three legs. Three pins *H* connect the two plates, and are adapted to engage the projecting fingers *J* of the gravity arms *D*. Our illustration shows one of the gravity arms just after it has been pushed to the left by one of the pins *H*. The locking plates are prevented from further rotation by a stop *K* on this arm, which engages one of the legs of the plate. The pendulum rod is swinging in the direction of the arrow, and as soon as it strikes the gravity arm at the left, it will swing it far enough to release the locking plate, permitting the latter to rotate and push the opposite gravity arm *D* toward the right. In the meantime, the pendulum on its return stroke will swing with the added impulse of the gravity arm just released. In the Colgate clock the pendulum is eight feet long, the rod weighs 76 pounds and it carries a bob weighing 330 pounds. The impulse given it by the gravity arm is a slight touch of less than two ounces at each stroke. This incredibly small pressure is ample to keep the pendulum swinging. The advantage of the gravity escapement is that the pressure of the clock train is not exerted on the pendulum, but merely acts to raise the gravity arms, and as the weight of these arms is constant, there can be no variation in the impulse given to the pendulum, no matter how the pressure of the clock train may vary. To prevent the locking plates *G* from rotating too rapidly when released, a fly is provided.

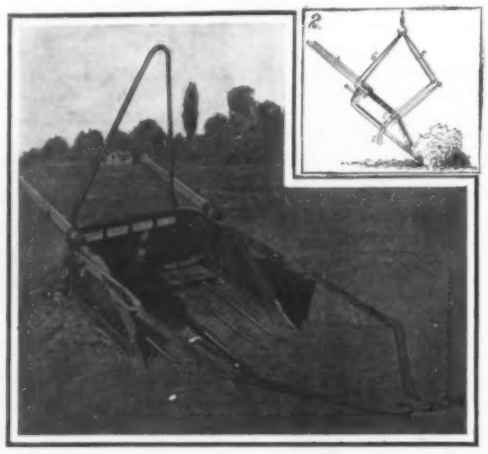
The pendulum of the clock is of the compensating type. The steel shaft carries a zinc cylinder, from the top of which the pendulum bob is suspended. As the shaft increases in length with a rise of temperature, the zinc sleeve expands and raises the pendulum bob sufficiently to compensate for expansion of the steel. The top of the pendulum bob is hemispherical, so as to prevent the accumulation of dirt or particles, which might disturb the weight and balance of the pendulum. The remontoir movement serves to drive the shaft *M*, to which is coupled the shaft which runs up to the dial works. The dial works are placed directly behind the dial, and consist of gearing necessary to make the minute hand move twelve times as fast as the hour hand.

Before setting the clock up in Jersey City, the movement was carefully tested at the factory of the Seth Thomas Company. One of our illustrations shows the clock hands mounted on their arbors, which project through a window of the factory. In this illustration, the two counterpoises of the hand are shown.

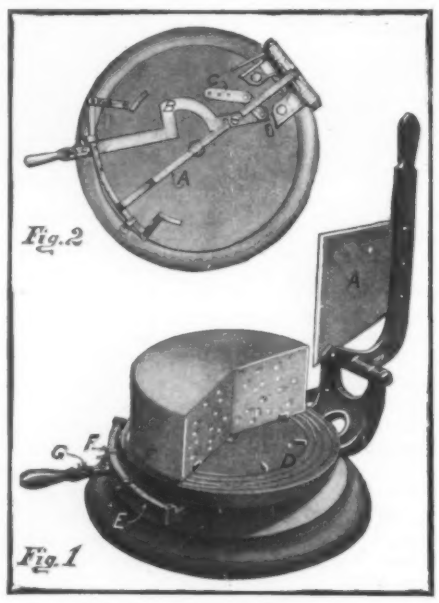
When in service the clock will be wound every day by an attendant, though it may run for four days without winding. It is expected that before this number issues from the press, the Mayor of Jersey City will have pressed the button that will start the gigantic hands on their endless journey.

A NEW TYPE OF FILTER.

A very simple and efficient filter has recently been devised for the purpose of filtering small quantities of water for use in the house or office. The filter when continuously running will purify five gallons of water per hour. One of our illustrations shows how the filter may be applied to a water cooler. The details of the device are shown in the other illustration, in which the parts are broken away to reveal the interior details. The water enters the filter from above, and is first caught in an aluminium cup *A*. Thence it passes out into a second cup *B*. Fitted in the inner aluminium cup is a thick layer of felt. The outer aluminium cup is similarly provided with a felt sleeve *D*. The water passes out of cup *A* into cup *B* through a ring of perforations *E*, and it issues from cup *B* through a second ring of perforations *F*, which are at a higher elevation than the perforations *E*. The two layers of felt act merely to remove the mechanical impurities, and to further purify the water and kill off the germs, an electric current is passed through the water between the aluminium cups. It will be observed that the cups are screwed into a hard rubber top plate and make contact, respectively, with the terminals *G* and *H*. The electric current used consists of eight dry cells, which by means of an ingenious switch are thrown into circuit with the cups only when the water is running into the filter. The effect of the electrical current is to break up the water temporarily into hydrogen and oxygen with a large proportion of ozone. This acts to kill off germ life. Outside of the cup *B* is a glass reservoir, in which the purified water is contained. At the lower end of this reservoir there is a mechanical filter of the ordinary type, consisting of a small chamber *K* filled with carbon and quartz sand. This serves to trap any impurities that might possibly enter the glass reservoir.



GATHERING AND LOADING FORK.



A COMPUTING CHEESE CUTTER.

A NEW TYPE OF FILTER APPLIED TO A WATER COOLER.

INTERIOR DETAILS OF THE FILTER.

The cost of operating this filter is very slight. In practice it has been found that the battery need not be renewed oftener than once a month. A patent on this improved filter has recently been secured by the Electric Perfect Filter Company, of 111 Broadway, New York, N. Y.

GATHERING AND LOADING FORK.

Pictured in the accompanying engraving is a dumping fork of ingenious construction for gathering and loading such material as manure, hay, and grain. The fork is so designed that an operator may conveniently release the load-sustaining section of the fork from its locking device while the fork is elevated, and the weight of the load will then automatically carry the fork to dumping position. At the same time a scraper will automatically pass over the load-sustaining section, cleaning the fork and assisting in the discharge of the load. The fork comprises a series of parallel tines, which are curved upward at the rear and are inclosed at the sides by means of metal walls. This constitutes the load-sustaining section of the fork, and it is provided with two rearwardly-extending handles, which are indicated at *A* in the illustration. The scraping device consists of a plate *B* of L-shaped cross section, which bears against the tines. At each side the scraper is provided with studs *C*, which project through slots in the side walls of the fork, and engage the slotted curved arms *D* of a pair of opposite levers. Hooked to the opposite ends of these levers is a bale *F*. The levers are pivoted to the sides of the fork at *E*. The rear end of the fork is also provided with a bale *G*. When loading the fork it is dragged along by means of a bale *F*, and the parts are then in the position indicated by Fig. 1, with the scraper at the extreme rear end of the fork. A catch *H* engages the scraper, and serves to hold it in this position. When raising the fork and moving it to the dumping position, the two bales *F* and *G* are hooked together. The load-sustaining section will then assume a horizontal position. When the operator desires to dump the fork, he releases the catch *H* by drawing a cord, and the parts will then slide to the position shown in Fig. 2, owing to the weight of the material on the tines. As the levers swing on their pivots *E* they draw the scraper along the tines, clearing the latter and assisting in dumping the load. The inventor of this fork is Mr. Marius A. Heffner, of Arenzville, Ill.

A COMPUTING CHEESE CUTTER.

Illustrating the accompanying article is a cheese cutter of the type adapted to cut a predetermined amount of cheese and automatically compute the price of the slice cut. In Fig. 2 the mechanism may clearly be seen, because the cheese table and an operating board have been removed. To the circular base of the cheese cutter a bracket is secured, on which is hinged a blade *A*. Hinged to the base near the bracket is a lever *B*, provided with an offset to clear the pivot pin on which the cheese table is mounted. The short end of the lever *B* is connected by a link to a plate *C*; the latter is secured to the under side of the operating board, so that when the lever *B* is swung on its pivot, it will rotate the operating board through a limited arc. Over the operating board the cheese table is mounted, and this is provided with lugs, which are adapted to be engaged by spring pawls carried by the operating board. A spring pawl carried by the bracket prevents a return motion of the cheese table. Thus when the lever *B* is operated, the operating board will move back and forth with it, but more slowly than the lever, whereas the cheese table, owing to the arrangement of the pawls, will move only in one direction. The cheese table is provided at its upper face with concentric circles, which enable one to center the cheese on the board. Projecting lugs *D* serve to retain the cheese in such position. The operating handle *B* swings along on arc *E*, on which two stop pieces *F* are secured. These stops may be adjusted to any desired position. Mounted on the lever is a spring pawl *G*, which may be temporarily turned inward to engage the stops. On the arcuate plate *E* graduations are marked, which will permit the operator to determine in advance the size of the slice he is cutting, and also the price of such a slice. The inventor of this improved cheese cutter is Mr. J. W. Isler, of Goldsboro, North Carolina.

Remarkable expansion has taken place in the Indian manganese industry, statistics showing that while the total quantity of manganese ore shipped through the Kidderpore Docks during the whole of the year 1906 was 14,587 tons, the shipments up to end of October last year amounted to 40,349 tons. The Carnegie Steel Company, of Pittsburg, has acquired large manganese properties in India, and it is expected that these figures will be yet further increased.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COLLAR.—G. F. MCMANUS, New York, N. Y. In the ordinary fold collar, it is very difficult to tie a bow tie, without rumpling the vertical portion, and yet tight enough to retain the bow horizontal and in proper position on the collar. This tie can be tied loosely enough to prevent rumpling and the slits will retain the bow horizontal and in proper position on the collar.

Electrical Devices.

CHOKE-COIL.—L. O. LANGWORTHY, Bradford, Pa. The entire absence of heat; perfect adjustment of voltage and clearness of light on a picture; economy over all forms of rheostats; freedom from excessive current on short circuit; and the indestructibility of the coil under actual conditions of service, are the advantages in this invention for use on alternating arc lamps, especially those used with moving picture machines.

APPARATUS FOR PRODUCING ELECTRIC DISCHARGES THROUGH GASES.—A. SCHNELLER, Ginneken, near Breda, Netherlands. An object of this invention is to provide new and improved apparatus whereby electricity is discharged through gases, in such apparatus a fluid dielectric being utilized. Many former difficulties are overcome by the present improvement, a fluid being utilized which is highly resistent even at the high tensions employed.

Of Interest to Farmers.

HAY-PRESS.—E. W. KELSEY, Collinsville, Tenn. The invention operates the plunger shaft from a projection extending downward from the under side of a main cam, said projection being in position to act upon the short arm of a lever, the long arm of said lever being attached to a plunger shaft, so that as soon as this shaft is released from the main cam the plunger returns to its normal position after having completed its rearward stroke. It is an improvement on the press for which Letters Patent were formerly granted to Mr. Kelsey.

WEEDER AND CULTIVATOR.—O. J. GONZALEZ, Palms, Cal. One purpose here is to provide a type of implement, that will combine in one device the functions of a cultivator and weeder, and to so construct the device that while cultivating the ground over which it is drawn it will destroy all weeds in its path without stopping or clogging, whether the weeds be one inch or two feet high, or growing scattered or thick and matted.

Of General Interest.

PROCESS FOR EXTRACTING METALS.—D. R. ROBERTSON, Denver, Col. The improvement relates to the extraction of metals from substances containing them, and more particularly to the separation of so-called precious metals, and particularly to the separation of gold, silver, and copper from their ores. The process requires no special skill.

UMBRELLA.—T. A. STOMBAUGH, St. Marys, Ohio. The construction permits the outer half portions of the bows of the frame to telescope within the remaining portions thereof, and provides means for holding the bows extended full length, under stress of a distended covering when the umbrella is raised; it automatically closes all the bows when collapsed, and folds the stretcher rods by same movement, permits the outer sections of bows to be telescoped, and permits the frame to be bisected, whereby the length of the folded umbrella is reduced one-half, and a neat, compact package is provided.

BAG OR PURSE FASTENER.—L. B. PRAHAR, New York, N. Y. One of the purposes of the inventor is the provision of a fastener particularly adapted for bag frames and which comprises but few parts, the latching member having rocking movement to and from the keeper or keepers it is adapted to engage. It may be effectually applied to any bag frame.

RACK.—J. BOYLE, New York, N. Y. The invention refers to improvements in racks or rails adapted to be secured to the back of a chair, to the wall, or to any other suitable stationary body and serve to support coats, wraps, or other garments and the like. It may be normally left in its lowered position so as not to obstruct the passage, and for use may be readily moved to an extended position and firmly support garments.

FIRE-CURTAIN.—A. M. FULLER, St. Louis, Mo. In this case the invention relates to the automatic fire-proof protection of openings in buildings, and comprises a fire-proof curtain of asbestos or other suitable material, arranged to automatically cover doors, windows, and other openings, upon the temperature in proximity thereto reaching a predetermined degree.

SEALING-CAP FOR BOTTLES.—E. D. BETTS and E. VANDENBERG, Lancaster, N. Y. The object of this invention is to provide a sealing cap for bottles, that may be readily applied to the open neck of a bottle, and hermetically seal the broached receptacle for the preservation of any contents of the bottle that may remain after the bottle has been first opened and a portion of the liquid therein removed.

PICTURE-SUPPORTER.—E. F. BRADT, Schenectady, N. Y. The invention pertains to picture hangers and easels, and the principal object is to provide a support for pictures, which can be adjusted to fit pictures of different sizes. Another object is to provide a support which can be adjusted so that it can be hung on the wall under different conditions, or be supported with legs and a standard, as an easel.

MASSAGING DEVICE.—K. C. JOPLING, Memphis, Tenn. The aim of this invention is the provision of a device, by means of which toilet preparations can be effectively applied to the skin of the body, which has means for intermittently ejecting the preparation, and which is controlled in a simple manner by the hand of the user.

Hardware.

MICROMETER-GAGE.—C. A. KELLEY, Spring Lake, Mich. The purpose here is to provide a caliper or gage, which is graduated in such manner that it may be read more easily and quickly than others in its class, the graduations being most conveniently expressed in 64ths of an inch upon the rotatable thimble rigidly connected with the micrometer screw constituting one of the gaging points of the instrument.

STIRRUP.—W. D. MILLER, Saco, Mont. The invention embodies a stirrup-frame having a cross bar or bolt and an auxiliary frame for securing the stirrup to the stirrup strap, having a hook normally engaging under the bolt; the auxiliary frame being movably seated in the upper portion of the stirrup-frame, with its hook so positioned that it will disengage the bolt when pressure is brought to bear on the front of the auxiliary frame.

WRENCH.—H. C. MOORE, New York, N. Y. This wrench is intended for use by machinists and handy craftsman, or pipe fitters. The object of the invention is to produce an implement which is simple in construction and which will have improved means for controlling the amount of opening between the jaws.

COMBINATION-TOOL.—J. M. KIEHLE, Coudersport, Pa. This improved tool comprises a nail puller, a chisel or screw-driver, a hammer, a staple puller, and a claw, and is adapted to be used for a variety of different purposes, such as repairing fences, opening boxes or loosening siding.

NAIL.—W. HORNER, Reed City, Mich. More particularly the invention relates to that type for use in blind nailing through the tongue of matched boards used for ceilings, floorings, and the like. The inventor's object is to provide a nail which will not split the wood, which is rigidly held in proper relationship to the grain of the wood, and which may be readily driven into place so as not to interfere with the edge of the adjacent board.

Household Utilities.

STOVE AND FURNACE.—W. R. FENERTY, Louisville, Ky. The invention relates more particularly to that type of stove or furnace in which there is provided a fire chamber surrounded by a suitable casing, and the object is to so construct the parts that the lower portion of the chamber, which often becomes burned out and requires replacing, may be removed and a new one inserted without dismantling the entire construction or removing the major portion of the casing or the upper portion of the chamber.

CURTAIN-POLE.—J. KRODER, New York, N. Y. The object of the present invention is to provide a pole arranged to permit of conveniently engaging the knob with the end of the tubular pole, and in the case of telescoping tubular poles to allow of readily engaging one pole section with the other. It relates to curtain poles such as shown and described in the Letters Patent of the U. S., formerly granted to Mr. Kroder.

Machines and Mechanical Devices.

SODA-FOUNTAIN.—H. K. SMITH, Union, S. C. The inventor seeks to provide improvements in the means for exposing a portion of the jar so the height of its contents will be made visible, also to arrange the filling means so the jar may be filled from front of fountain and without necessitating the removal of the jar, and further, improvements in the dispensing mechanism whereby the quantity of syrup dispensed may be gaged, and whereby the syrup in the discharge tube will be drawn back by the readjustment of the dispensing devices to normal position so as to avoid drip from the syrup tube. Mr. Smith has secured a patent for another soda-fountain, in which, in connection with the syrup holders and the devices for dispensing syrup therefrom, he provides electrically operated means for actuating the devices, and provides in connection with the individual devices in the respective syrup holders electrically operated means for actuating the respective syrup dispensing devices.

ENGRAVING-MACHINE.—R. TURNER, New Canaan, Conn., and B. R. CORLEY, New York, N. Y. The invention relates to plate engraving, and its object is to provide a machine, arranged to permit of conveniently, accurately, and quickly producing sunken letters, signs, numerals, characters, and ornaments, and any desired combination thereof, in copper plates, steel plates and the like, and without the use of skilled labor.

VALVE-LIFTER.—D. ROHEN and D. E. FORTON, Evart, Mich. This lifting device for foot or check valves is for use in tubular wells, and is especially designed to be employed in connection with sand pumps, wherein it forms a permanent and detachable part of the same, and is adapted not only as a means for grabbing and lifting the valve, but also to bore or drill to loosen the sand in the well-pipe in order that it may be readily pumped out.

TRANSMISSION MECHANISM.—L. E. MAHOUT, 10 Rue Léopold Robert, Paris, France. The invention permits the following: Perfect equilibrium and absolute gripping of the belt in all its positions on the cones. Direct drive on differentials at all speeds. Clutching the engine progressively when starting, positive transmission of power after starting. Changing from forward to backward running without declutching. Utilizing engine for braking vehicle. Throwing rear axle of transmission out of gear when running down easy gradients to run free and rotation of transmission mechanism to no purpose be avoided. Increase in range of vibrations of speed afforded by cones with a less crowded arrangement of the mechanism.

BOOKBINDER'S STRIP-APPLYING MACHINE.—C. J. DUGGAN, Chicago, Ill. The mechanism enables the joining of the leaves to be accomplished by the aid of a single roll of ribbon or muslin to which glue or liquid paste is constantly applied; enables the leaves to be joined while stationary and flat; enables the glue or other adhesive material to be heated before being applied to the joining strip or to the leaves or sheets.

MOLDING-MACHINE.—J. P. COSTIGAN and J. F. J. COSTIGAN, New York, N. Y. In this patent the invention has reference to molding machines, the more particular object being the production of a machine for molding pipe coverings and the like, in semi-cylindrical sections. The machine may be used for molding pipes either in the form of cylinders or semi-cylinders as desired.

MACHINE FOR WRAPPING GRAFTS.—W. H. BELL, Huntsville, Ala. In this instance the invention relates to grafting, and its object is the provision of a new and improved machine for wrapping twine or the like around the stock and scion, with a view to quickly and securely fasten the scion in place on the stock.

Prime Movers and Their Accessories.

ROTARY ENGINE.—T. ASHLEY, 8 Cemetery road, Louth, Lincoln, England. By the present invention there is an adjusting device for actuating a steamtight device at the side of the revolving piston, and the sliding abutments in the cylinder walls are provided with steam tight packings which are also capable of being taken out of the cylinder through the side of the cylinder cover.

DAMPER-REGULATOR.—C. C. KOSTER, New York, N. Y. The aim of this improvement is to produce a regulator for use on steam boilers, furnaces, heaters, and the like, and arranged to accurately and automatically adjust the damper with a view to control the burning of the fuel and the generation of the steam in the boiler. It relates to regulators such as shown and described in the Letters Patent of the U. S., formerly granted to Mr. Koster.

Railways and Their Accessories.

AUTOMATIC RAILWAY-SWITCH.—I. A. CALL, Bancroft, Idaho. The switch is adapted to be operated from a train or engine while in motion, and the inventor's object is to provide a switch of the stub rail type, which will not be apt to clog from snow, dirt, or other cause, nor from contraction or expansion of the rails at the switch. The mechanism is located above ground or on a level with the track and not subject to disadvantages of underground or sunken parts.

Pertaining to Recreation.

AMUSEMENT-RAILWAY.—J. H. DEWEY, New York, N. Y. This invention has for its purpose the provision of means causing a car in its travel to rise and fall and to cause the body of the car to revolve and rock from side to side, simulating the rolling and pitching of a boat. There are no points in the car at which passengers will not experience its motions.

Pertaining to Vehicles.

CUSHION ATTACHMENT FOR AUTOMOBILES.—J. E. MARRINER, Newton, Mass. One purpose of this invention is to provide a cushion body support for automobiles and other vehicles of like type, cars, car-seats, etc., which device is capable of convenient and expeditious application. Also a purpose to provide a safe support for a vehicle even should all of the pneumatic cushions become deflated.

COMBINED CARRIAGE ROBE, CUSHION, AND ATTACHMENT FOR HOLDING TOILET ESSENTIALS.—KATE A. WERLE, Nazareth, Pa. The invention provides a novel combination with an infant's carriage robe or blanket and an attached cushion, of pendent pocket attachments to the cushion, which afford convenient means for the compact stowage of toilet articles, indispensable for the needs of an infant carried a distance in the vehicle having the improvement.

Designs.

DESIGN FOR OIL-CLOTH.—A. HUNSICKER, Weehawken, N. J. In this ornamental design for oil cloth the pattern is in imitation of beautiful lace work. Mr. Hunsicker has also designed another ornamental oil cloth comprising a prominently dotted band under which runs a branch on which appear at close intervals leaves in pairs, making a plain yet very effective arrangement of plant figures.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10765) J. S. M. asks: Will you kindly answer in your column of Notes and Queries the inclosed questions relative to Roman computation? I suppose the matter is simple enough, but I have never come across any work explaining it, nor any person whom I have asked who could throw any light on the subject. A. Very little is known concerning the method by which the Romans used their very inconvenient notation for performing the ordinary calculations. They are supposed to have used the abacus for all except the most simple problems. This instrument is in common use now by all Chinamen, and it is not difficult for any one to see it used wherever these men may be found. A description of the abacus may be had from any encyclopedia. There was a rod for each denomination of numbers to millions, seven rods each carrying five balls. Another set of short rods corresponded to these, and had one ball sliding on each. They could thus count by fives and carry by tens. Other rods supplied their need for calculating ounces. Further than this their business did not require them to go; they never needed to divide the distance of the sun by the velocity of light. They died in total darkness in regard to both of these data of the universe. As we said at the outset, we do not know the detail of the method by which the Romans made their calculations. Their mode of writing numbers was not like ours by placing like denominations in the same column, but each letter had its significance, and each number could be added by itself on the abacus, since each rod meant a denomination.

(10766) N. L. asks: What causes the sparks between the trolley wire and trolley of an electric car in motion, also the sparks which occur sometimes between the wheels and rails? A. A spark occurs whenever there is an air gap between the trolley wire and the trolley, or between the wheel and the rail. A little gravel on the rail will produce the latter as the wheel strikes it, and a jarring will cause the trolley to leave the wire. 2. Please give the colors in succession that show upon steel in tempering, from the lowest to the highest temper. A. The colors upon steel vary from deep blue to a high straw color. The blues indicate low, and the straw colors indicate a high temper. The tempering is an individual matter which cannot be taught by a book. 3. Is the United States superior to all other countries in mechanics? If not, what country ranks first, as a whole? A. We think that mechanics in the United States are among the most skillful of any in the world. 4. Do either the inside or outside wheels of a railway car slip in going around a curve? If not, how is this difficulty overcome? A. Both the inside and the outside wheels may slip in going around a curve. 5. In your estimation, in what field are the opportunities better—mechanical or electrical engineering? A. Both mechanical and electrical engineering are good fields for any young man. Each one should follow his preferences. Every one who would enter either profession nowadays should be highly educated. Both mechanical and electrical engineers pursue very nearly the same studies at first, and toward the last of the course take different work. An electrical engineer may soon learn mechanical engineering, and *vice versa*. 6. Is it a fact that 99 per cent of the energy in a ton of coal is lost in transforming that energy into incandescent electric lights, that is to say, is only one per

cent of the energy utilized in electric lighting when coal is used as the source of energy? A. It is not true that 99 per cent of the energy of the coal is lost in transforming it into incandescent electrical light. In small steam plants 85 per cent may be lost, and in the large powers, where 1½ pounds of coal produce one horse-power, the loss drops to near 80 per cent of the coal value.

(10767) W. A. G. asks: 1. Kindly show a circuit of three or more gas jets as wired for electric gas lighting. A. To light three gas jets with one coil, and at the same time run the circuit of the secondary coil through each gas burner, connect to the wires of the igniter on the jet, and carry the circuit back to the coil again. This will make a complete circuit from one pole of the secondary around to the other pole. Connect the battery to the primary of the coil, and the switch. This makes another circuit complete. On closing the switch, a series of sparks will be thrown across the gaps at the burners, if the work has been properly done. 2. How should a Ruhmkorff induction coil be connected to the circuit—the primary or secondary being used, or both? A. The battery and switch are in the primary circuit of the coil; the igniters in the secondary circuit. 3. Is there any danger in the wiring, except where it is near the gas pipes? A. There is no danger except where a spark is produced. 4. Are there any liabilities from fire due to the high current? A. There should be no fire set by a battery current. 5. Do the batteries have to be switched in, or is it not necessary? A. The battery is brought into action by closing the switch. At other times it is not in action.

(10768) M. L. T. asks: 1. In the so-called "Highlow" lamp, is the small loop of filament which is used for the small candle-power of a greater resistance than the large one? If so, what is its resistance in comparison with the large one? A. We do not know the resistance of the filaments of the "Highlow" lamp, but the resistance of the side which gives the least light must be much greater than that of the side which gives the brighter light. 2. Is a silk watch chain any protection to a watch from its being magnetized when being carried in the pocket? The first person claims that he wears a silk watch chain while working about a machine (which by the way is a 150-kilowatt rotary converter, 550 volts direct current) so that if it should hit the field casting, his watch would not receive the magnetism by its traversing the chain as it would if it were gold. I claim that the material of the chain would not affect the watch becoming magnetized, but if brought near enough to the machine, the watch would receive the magnetism, even if it were in the pocket. I have always read that magnetism had no insulator; according to this, I believe the silk chain to be no protection from magnetism. Will you please state your opinion of this? A. Your friend and yourself seem to be a little mixed in reference to magnetism, silk watch chains, etc. You are right that magnetism passes through space. It has no insulator, excepting iron. It does not traverse a wire at all. It whirls around a wire in which a current of electricity is flowing, and causes the current to move a magnetic needle, and thus makes voltmeters and ammeters possible. Silk on the other hand is an insulator of electricity, not of magnetism. Electricity cannot get off a wire covered with silk. Gold is a conductor of electricity, and if a gold watch chain touched any uninsulated metal which was carrying a current, a man who might touch the chain in that position would receive a shock. If such a chain should touch the field casting only, nothing could happen, since the field casting is not carrying a current of electricity, but is only magnetized.

(10769) H. S. N. asks: I have been a reader of your paper for several years, and always enjoy reading it. I should like to submit a problem for solution. The problem is this: Several years ago I took a picture of a fast train while running, a Michigan Central flier, at a point about two miles east of Decatur. On development the plate showed a blur of 1/32 inch, i.e., the pilot did. I used a Vive extra rapid plate; the focus of the lens was 6 inches; the distance of the engine, the pilot, from the camera, 50 feet; the length of exposure, 1/100 of one second; camera was placed at an angle of 15 deg. with the track. What was the speed of the train? The camera was a Vive, 4¼ x 4¼, meniscus lens. A. The solution of your problem of the speed of the train is not difficult, at least so far as a sufficiently close approximation is concerned. Start with the fact that the image of the pilot moved 1/32 inch during exposure. Since the lens is 6-inch focus and the pilot is 50 feet away, the pilot moved across the line drawn through the center of the lens, 100 times 1/32 inch, or 3.125 inches, since 50 feet is 100 times 6 inches. And since the camera made an angle of 15 deg. with the track, we must divide the 3.125 inches by the sine of 15 deg. to find the distance the pilot moved during the exposure. This gives 12.07 inches as the distance the train moved in the time of exposure, or 1/100 second. In one second it moved 1,207 inches, or 100 feet 7 inches. This is a speed of somewhat over 71 miles per hour. As we said above, this is an approximate solution, but still not far from the result which an exact solution would give.

(10770) O. B. P. asks: I am greatly interested in the articles published in the SUPPLEMENT on experimental electrochemistry. It has occurred to me that the part water plays in promoting chemical reaction between compounds would also furnish an explanation why water thrown on the flames of a burning building appears to aid combustion in some cases. Does it play the part of a dissociant? A. It is not obvious to us that there is any connection between putting a minute quantity of an electrolyte into a large quantity of water and putting a small quantity of water upon a large fire. In the case of dissociation it is not possible to use the dissociated substance as separate chemical substances. Thus, you cannot get hydrogen and chlorine by dissociating HCl in water. There are H ions and Cl ions in the water, and yet no free H, nor any free Cl. Water is not the substance which is dissociated, but electrolytes are dissociated when a small quantity is added to water.

(10771) G. A. D. asks: Would you kindly inform me whether it is possible to build a brick smokestack or chimney 150 feet high, either square or round, which will be strictly plumb from top to bottom? A. In reply to your question as to whether it would be possible to make a brick smokestack or chimney 150 feet high, either square or round, which would be *strictly* plumb, we would say that of course it is impossible to make anything *mathematically* straight or plumb. The difficulty of obtaining proper foundation for a tall chimney, and the possibility of unequal settlement, make it especially difficult to have such a structure come as near to the absolute plumb line as many other structures would. It is customary to give the outer wall of a tall chimney a batter, making the chimney smaller at the top than at the bottom, both for reasons of economy and stability.

(10772) J. N. P. says: 1. Why and how does water put out fire? Why does the water have the same effect whether hot or cold? A. Water puts out a fire by reducing the temperature of the flame below the point of ignition, and is especially efficient for this purpose because of the large amount of heat that is required to turn it into steam. It is almost as effective when hot as when cold, because of the great amount of latent heat in the water. 2. Does the sun shining directly on a cooking stove have any effect upon the cooking? Does it lessen the baking in any way? If when shining on a fire in an open grate, does it reduce the heat? A. The sun shining directly on a stove or fire in an open grate tends to increase the temperature slightly, just as it tends to increase the temperature of any other object. The bright sunlight, however, may make the fire appear less brilliant, and therefore appear to give out less heat. This effect, however, is deceptive.

(10773) J. B. E. says: What will be the approximate cost of installing an electric light plant to furnish 1,000 16-candle-power lights and run one elevator (exclusive of light charges)? The approximate amount of fuel, coal, for ten-hour run? What horse-power steam outfit required? Is direct or alternating current better for private hotel plant? Is gasoline outfit practical for this purpose from standpoints of economy and reliability? What would be the difference in cost of fuel between steam and gasoline with coal at say $2.50 per ton? Is it practical to use exhaust steam in radiators for heating house? Do you consider underground tank with air pressure preferable to elevated gravity pressure tank for private water-works? A. An electric light plant furnishing 1,000 16-candle-power lights and running one elevator will require an engine which will develop from 100 to 120 horse-power and a generator which would generate from 65 to 75 kilowatts. Such a plant will require from three to six tons of coal per ten hours, according to the type of engine and boiler that are installed. Direct current is as efficient and more simple for your purpose than alternating current, and is perhaps more economical and reliable than gasoline. It is perfectly practical to use exhaust steam in the radiators of a heating plant, and if the installation is properly made, this will give satisfactory results and be a great saving in expense. Either an underground pressure tank or gravity pressure can be satisfactorily used for private water works. Nothing is superior to the gravity pressure.

(10774) H. A. says: A cask of water is placed on a pair of scales. It weighs 50 pounds. If a fish weighing 15 pounds (salmon) is placed in the water contained in the cask, will it raise the weight of the cask or not? It is argued by some apparently smart men, but I want to lay down your word to them as proof. I contend that the cask then weighs 65 pounds. A person weighs 140 pounds before dinner, does he weigh any more after a hearty meal, say of 1½ pounds? It is generally contended here that he does not. I say he does. Who is right? A. If a cask full to the brim with water has a live fish put into it, as much water as the fish displaces will overflow. As a fish weighs the same as the water it displaces when floating in water, it follows that the cask full of water and fish weigh the same after the fish has been put into the water that the cask and water weighed before the fish was put into the water, that is, 50 pounds. If the cask was not full of water when the fish was put into it, and if no water overflowed when the fish was put into the cask, the weight of fish, water, and cask will be 65 pounds in the case you specify. The whole turns upon whether the fish is alive and whether the cask is completely filled with water. If a person is weighed after a meal, he will weigh as much more than he did before the meal as the weight of the food he has eaten. Common sense teaches this. If a person puts 1½ pounds of food into his pocket and gets upon the scales he will weigh 1½ pounds more than without the food in his pocket. Write stomach in place of pocket, and you will have the same fact. Or put nails in place of the word food. It will be equally true.

(10775) J. L. C. says: Which of either brass, iron, tin, steel, copper, or aluminium is the most affected by temperature, and what will its expansion be with a change of 60 deg. on a Fahrenheit thermometer? A. Tin has the highest co-efficient of expansion of the metals you name. A bar of tin 100 feet long will expand 0.87 inch if the temperature is increased 60 deg. F. Lead will expand 1.14 inches, and a mixture of one part tin and two parts lead (white solder) will expand 1 inch under the same circumstances.

(10776) A. S. L. asks: Will you kindly explain the following peculiar weather conditions? There was a fall of 2 inches of fine snow in this vicinity recently with the thermometer at 36 degrees, or 4 degrees above freezing, wind from the south, and the snow did not melt after falling. Last year we had a rain storm from the northeast, with the thermometer at 23 degrees, or 9 degrees below freezing, and the rain freezing after falling. In the latter case the thermometer rose slowly. A. The fall of snow when the temperature at the surface of the earth is above freezing is due to the fact that the temperature at the altitude of the clouds is below freezing. That the snow did not melt after falling was due to the cooling of the air so that the temperature was soon at freezing. The fall of rain when the temperature at the surface of the earth is below freezing is due to the opposite state of affairs; the temperature in the clouds is above freezing, warmer than it is below. That the temperature rose after the fall of rain took place may be explained by the heat which the rain gave off in cooling to the freezing point and freezing.

(10777) H. W. says: Kindly answer the following questions in the column of your paper entitled Notes and Queries, viz: 1. How is the power of a gasoline engine calculated? A. It is very difficult to accurately calculate the power of a gasoline engine. The horse-power is equal to the area of the piston in square inches, multiplied by the length of the stroke in feet, multiplied by the number of working strokes per minute, multiplied by the average pressure per square inch behind the piston, divided by 33,000. All of the quantities are easily determined excepting the average pressure in the cylinder. This will vary very greatly, according to the character and design of the engine and the richness of the mixture, the degree of compression and the time of ignition. As a general average, it would vary between 50 and 150 pounds. 2. To what temperature is the air in the cylinder of a gasoline engine heated by the combustion of the gasoline? A. The temperature in the cylinder of a gasoline engine is even more difficult to determine than the average or maximum pressures. It would also depend on the richness of the mixture, the degree of compression, the size and shape of the cylinder, the efficiency of the cooling jacket, if there be any, and the time and character of the ignition. The maximum temperature probably varies between 1,500 and 2,500 degrees; but all parts of the mixture might not have these temperatures at the same time.

(10778) R. M. G. says: 1. Can you inform me what coefficient of friction to use in figuring the power of multiple-disk friction clutches? Surfaces to be cast iron to cast iron, running in oil. A. We know of no published data giving the coefficience of friction on friction clutches. For a clutch running in oil, we should not consider it safe to use a coefficient larger than about 0.05. 2. Example: How many surfaces would be required to transmit, from rest, a torque equal to 1,000 pounds pull on a 3 3/16-inch radius (i.e., radius equal to the effective radius of the disks)? Clutch disks 8 inches diameter, 4-inch hole = 37.69 square inches effective area. *R* = about 3. 3/16 inches. Pressure on clutch plates, 100 pounds. A. Assuming the coefficient of friction on the clutch you mention, it would require 200 surfaces. 3. What is the better way to increase the power—by increasing the area, the number of surfaces, or the pressure? A. The best way of increasing the power of a friction clutch is first by increasing its diameter, thereby increasing the lever arm through which the force acts; second, by increasing the pressure; third, by increasing the number of surfaces in contact. Increasing the area of the surfaces without increasing the pressure has no effect. 4. Can you refer me to some work that treats of this subject fully? A. We are sorry that we cannot refer you to any work that treats of this subject. We think you will find of interest an article on clutches in SUPPLEMENT No. 1448.

NEW BOOKS, ETC.

MEDICO-PHYSICAL WORKS. Being a Translation of Tractatus Quinique Medico-Physici. By John Mayow. Chicago, Ill.: The University of Chicago Press. 12mo.; cloth; 331 pages; illustrated. Price, $1.35.

John Mayow was born in May, 1643, and after due course of study was graduated B.C.L. from All Souls' College in 1665, and D.C.L. in 1670. He studied "physic" and became noted for his practice of it, largely in the city of Bath. In 1679, he died, aged 36. During this short life he wrote, in Latin, five treatises, the first two of which were published at Oxford in 1668, and the last three, together with a revised edition of the first two, at the same place in 1674. Mayow's works received but scant notice in his own generation, and it was not until the great revolution in chemical theory some hundred years later that those who came across his writings in libraries, were surprised to see that Mayow foretold the discovery of oxygen, and that the new chemistry was to a great extent found in his work. These quaint old writings are translated in a manner to retain the naïve spirit of the original. This volume of the Alembic Club's reprints deserves no mean place in all libraries where attention is paid to the history of chemistry.

USEFUL INFORMATION FOR PRACTICAL MEN. Compiled for E. I. du Pont Nemours Powder Company. Philadelphia: Dando Printing and Publishing Company, 1908. 32mo.; 216 pages. Price, $1.

This is one of the best technical handbooks that have recently come under our notice. As it is printed on a high quality of thin paper, the pocket book is unusually small for the large amount of information is contains; and this compactness is gained in spite of the fact that at the end of the work there is inserted a memorandum book consisting of 50 pages of finely ruled section paper suitable for sketching to scale and making the necessary notes. The book opens with a set of general tables. This is followed by chapters on rock drilling, in which the three types, hand drills, machine drills, and percussion machine drills, are treated. There are chapters on rock-crushing machinery; on earth work, with rules for calculating quantities and weights; on cement, lime mortar, concrete and plaster; on masonry, containing complete tables of weights of stones and allied materials, and on bricks. Particularly good, though brief, is the section devoted to boilers and that on pumps, fans, and blowers. There are chapters devoted to hoisting engines, tramways, and light locomotives. Some twenty pages are devoted to iron and steel. Then follow chapters on ropes, cables, and hawsers, and on roofing. Naturally, in a handbook brought out by a great powder company, the final chapters on explosives will prove particularly valuable. The nature of high explosives is explained, and directions are given for their handling in the various uses to which they are put.

GAGES AND GAGING SYSTEMS. Design, Construction and Use of Tools, Methods and Processes Involved. By Joseph W. Woodworth. New York: Hill Publishing Company. 8vo.; cloth; 249 pages, 258 figures. Price, $2.

A reference work and text book for all practical men who are engaged in the manufacture of precision tools and interchangeable parts. In the entire work, all obsolete practices and methods have been eliminated, and the treament has been confined to the design, construction, use, and adaptation of the numerous tools and systems illustrated. The descriptions have been made as brief and concise as possible, always of the most up-to-date and approved methods of construction, yet at the same time, the fundamental principles involved have not been neglected. The majority of the tools taken and methods described, have been selected from the columns of "The American Machinist" and "Machinery"; however, a great many of the articles are original. This work should assist the present day mechanic in the design, construction, and use of expedient and economical gages and gaging systems.

METHODS FOR EARTHWORK COMPUTATIONS. By C. W. Crockett. New York: John Wiley & Sons. 8vo.; cloth; 114 pages. Price, $1.50.

In this book a series of rules has been formulated by which the terms necessary for the numerical computation of volumes, either by the prismoidal formula or by the average end area method, may be written directly from the notes. In each of the first three chapters a general rule, applicable to any case, is first stated; and then special rules, applicable to the cases that most frequently occur in practice, are given, these rules gaining in simplicity as their application becomes more and more limited. Tables and diagrams have been issued in large numbers, each prepared for a special case and necessarily limited in extent, and many of them are valuable in their separate fields. But the slide rule has been coming into such general use in recent years that the author has deemed it advisable to prepare one, described in Chapter VI, that may be used for earthwork determinations. The adopted arrangement of the scales makes the instrument general in application, so much so that it will enable the

computer to determine the volume in any case considered in this book.

RUBBER TIRES AND ALL ABOUT THEM. Pneumatic, Solid, Cushion, Combination. For Automobiles, Omnibuses, Cycles, and Vehicles of every description. By Henry C. Pearson. New York: The India Rubber Publishing Company. 8vo.; cloth; 282 pages. Price, $3.

Rubber is not, as is almost universally supposed, the sap of a tree. It is a thick, milky juice exuded by the spongy bark of certain tropical trees when they are punctured. Although many hundreds of species produce this sap, but a few are of commercial value. The best rubber comes from Peru, but since Para, in Brazil, is the port by which it reaches the markets of the world, Peru gets no credit for its production. The process of making crude rubber into the commercial article is largely one of baking, with the addition of sulphur. In inferior grades certain cheapening substances are added, but in first-class automobile tires the utmost care is maintained that no adulteration should take place. The major part of the work treats of tires, tire tools, inner tubes, and the relative advantages and disadvantages of the various forms now manufactured, both in this country and abroad.

WHAT ROME WAS BUILT WITH. A Description of the Stones Employed in Ancient Times for its Building and Decoration. By Mary W. Porter. London and New York: Henry Frowde. 16mo.; cloth; 108 pages. Price, $1.40.

A delightful little hand-work of the stones used in the building of ancient Rome. In it, anecdote and historical fact are mingled with petrology in a very agreeable manner. The craze for rare stones for building purposes was more marked in Rome under the emperors, reaching its height with Augustus, than in any other country at any time. It was Augustus's boast that he found Rome of "brick and left it of marble." The stories of these mere inert building materials are so entangled with the records of greater deeds, that it is impossible to speak of the one without recalling the other.

THE MATHEMATICAL THEORY OF ELECTRICITY AND MAGNETISM. By J. H. Jeans, M.A., F.R.S., Professor of Applied Mathematics in Princeton University. Cambridge: At the University Press, 1908. Cloth, 6½ x 10¼ inches; 536 pages; 137 figures. Price, $4.50.

Electromagnetism is founded upon many observations, experiments, and theories, yet its growth can be traced back to two facts—the property of becoming electrified when rubbed, possessed by amber, and the attraction that lode-stone has for iron. The observation of the first of these phenomena is attributed to Thales of Miletus (640-548 B. C.), while the second of them is mentioned by Lucretius. We now know that these two peculiarities are not isolated from each other, but are closely joined links in a great and intricate chain-work of manifestations. Of electromagnetism there are three branches; electrostatics; magnetism, or more correctly magnetostatics; and electrodynamics. Electrodynamics deals with the motion of magnetism and electricity, and in the development of this branch it was that the two groups of magnetism and electricity were found to be related. The relation is a reciprocal one; magnets in motion producing the same effects as electricity at rest, and electricity in motion producing the same effects as magnets at rest. The treatment of the work is mathematical, and while rather awe-inspiring at first glance, is not as severe as it appears.

CLIMATES OF THE UNITED STATES IN COLORS. By Charles Denison. Chicago, Ill.: The W. T. Keener Company. Quarto; cloth. Price, $1.

Much painstaking care is shown in the preparation of these charts, and physicians should welcome their appearance with delight. They will no doubt form a valuable addition to medical libraries.

CHILE OF TO-DAY. Its Commerce, Its Production, and Its Resources. National Yearly Publication of Reference (1907-1908). By Adolfo Ortúzar. New York: Tribune Association. 8vo.; paper bound. Price, $5.

All who are concerned in the progress of our sister republics of South America will be much interested in "Chile of To-day," by Adolfo Ortúzar. The illustrations shown instance of a degree of culture and architectural refinement that will no doubt surprise the ignorant, although some few of our citizens have long been familiar with the great resources of the countries to the south of us. As a year-book, the information contained is most valuable, and should cause a wide demand for the work.

HANDBOOK FOR MOTION PICTURES AND STEREOPTICON OPERATORS. By C. Francis Jenkins and Oscar B. Depue. Washington, D. C.: The Krega Company, Inc. 16mo.; leather bound; 132 pages. Price, $2.50.

A text book or book of reference in the several branches of the motion-picture art, from the perforation of the film through the operations of photographing, developing, printing these pictures, alone and in connection with the lantern projection of still pictures. It is as complete as the present state of the art permits, and contains a number of recipes and formulas that should prove useful.

CLIMATE CONSIDERED ESPECIALLY IN RELATION TO MAN. By Robert De Courcy Ward. New York: G. P. Putnam's Sons. Illustrated; 8vo.; cloth; 372 pages. Price, $2.

Climate is based on a collection of notes which the author has been accumulating for the past ten years. It does not attempt to present any very new or original material, perhaps, but it does aim to co-ordinate and to set forth clearly and systematically the broader facts of climate in such a way that the general reader, although not trained in the "technicalities of the science," may find it easy to appreciate them. At the same time, the needs of the teacher and student have been kept constantly in mind, and the subject matter has been arranged in such a way as seems to best adapt it for the purpose of thorough study. The section devoted to tropical diseases should prove worthy of attention from those who intend to travel in warm countries. In fact, much information of vital importance to travelers is contained in this work. To the person who desires to be well informed, and have an intelligent knowledge of the world in which we live, the many interesting elements of climatology expressed in the pages will provide reading of a very high order of interest.

PRACTICAL EARTHWORK TABLES. By C. E. Honsden. London and New York. 16mo.; cloth; 44 pages, illustrated. Price, 90 cents.

The main object in estimating for any project whatever is to secure accuracy in preparation, and reduction of labor in getting at cost. Earthwork tables have been prepared with a view to reducing work necessary in the preparation of estimates for roads, railways, canals, earthen dams, and the like.

CONVERSATIONS ON ELECTRICITY. By Joseph G. Branch. An Elementary Work Written Especially for Engineers and Students. First Part. Chicago: Rand, McNally & Co. With 105 illustrations. 12mo.; cloth; 282 pages. Price, $2.

A highly to be recommended work upon the elementary principle of electricity. The type is large and clear, and the illustrations numerous. A slight error appears on page 90. Referring to Fig. 26 on the preceding page, the letter *E* is spoken of, although no such letter appears in the figure. The meaning, however, is quite plain in spite of this mistake of the printer.

PRACTICAL HYDRAULIC TABLES. Water Supply and Drainage. By C. E. Honsden. London and New York. 16mo.; cloth; 105 pages. Price, $1.25.

These tables and diagrams were originally prepared for personal use. They are designed to be serviceable in a practical manner, and their application is upon simple lines. With their assistance it is possible to quickly and easily ascertain the sizes and cost of pipes required in a complicated water-supply system.

SAFE BUILDING CONSTRUCTION. A Treatise Giving in Simplest Forms Possible Practical and Theoretical Rules and Formulæ Used in Construction of Buildings and General Instruction. By Louis De Coppet Bergh. New edition, thoroughly revised throughout. New York: The Macmillan Company. 8vo.; cloth; 436 pages, folding plates and tables. Price, $5.

"Safe Building Construction" is an outcome of the author's former work on construction, "Safe Building." Much of the former work has been retained, though the matter has been condensed whenever possible. The object of the work is to make the articles practical, and although based upon the science of mathematics in the strict sense, all useless theory is avoided.

ELEVATOR SERVICE. By Reginald Pelham Bolton. New York: Reginald Pelham Bolton. Quarto; cloth; 69 pages. Price, $5.

It is the only book which offers a basis for the duty of an elevator, and the means of comparison of the work of passenger elevators under different conditions. In it is presented for the first time a clear view of the relation of the elevator, with its passengers, to the building and its floors. The means of deciding the work which each elevator will accomplish, just what average conditions will bring about in the service of any business building, and the vitally important features of the combination of car size, load, and speed, with the number of floors to be served, are contained in its pages. It shows the value and defines the work to be obtained from express elevators, and gives the proper division of the building between local and express services.

THE BRAZIL OF TO-DAY. A Book of Commercial, Political, and Geographical Information on Brazil. Impressions of Voyage and Picturesque Data About the Principal Cities, Prominent Men, and Leading Events of Our Days. With Illustrations and Statistics. By Arthur Dias. Nivelles, Belgium: Lanneau & Despret. 8vo.; paper bound; 636 pages.

Brazil is but a million square miles less in area than the United States, her climate is excellent, and her resources enormous. For her commercial development, however, capital is necessary. We Americans should look into this matter, for under her stable government, protection for all sorts of enterprise is to be found. The Germans have realized this, and have flocked to this rich region in numbers, settling there, and aiding materially in the building up of the trade and prosperity of the land. That our neighbor wishes to be better known is shown by the publication of the translation of "The Brazil of To-day," a full description of the country, which is illustrated profusely. The same thing may be said of Brazil that can be said of almost any other of the large South American countries: *We should turn more of our attention to them.*

DREDGING FOR GOLD IN CALIFORNIA. By D'Arcy Weatherbee. San Francisco: Mining and Scientific Press. 8vo.; cloth; 217 pages, illustrated. Price, $4.

There is much diversity as to the merits of the various kinds of drills, owing to the youth of the industry. Mr. Weatherbee can be given full faith both in judgment and in experience.

TELEPHONE CONSTRUCTION, INSTALLATION, WIRING, OPERATION, AND MAINTENANCE. By W. H. Radcliffe and H. C. Cushing, Jr. New York: The Norman W. Henley Publishing Company. 16mo.; cloth; 125 illustrations; 171 pages. Price, $1.

The purpose of this book is to furnish a work that in no way conflicts with other publications on telephony either of encyclopædic or less pretentious scope. Intended for the amateur, the wireman, or the engineer who desires to establish a means of telephonic communication between the rooms of his home, office, or shop, it deals only with such things as may be of use to him rather than with theories which would have place only in theoretical works. The reader is assumed to know absolutely nothing of telephony, and no intricate mathematics are used nor is mention made of any apparatus, circuit, or system which is not thoroughly illustrated and described with respect to its construction, installation, wiring, operation, and maintenance. The equipments and the methods of wiring presented have been selected with great care from those which have been in use for a sufficiently long time by the Bell and independent companies for their practical value to become thoroughly known.

THE METALLURGY OF THE COMMON METALS, GOLD, SILVER, IRON, COPPER, LEAD, AND ZINC. By Leonard S. Austin. San Francisco, Cal.: The Mining and Scientific Press. 8vo.; cloth; 407 pages; 171 illustrations. Price, $4.

This outline of the metallurgy of the common metals, gold, silver, iron, copper, lead, and zinc, is devoted to the description of the processes of winning the metals from their ores, and to the refining of these metals, except iron, the metallurgy of which is given only to the point where pig iron is obtained. Following the description of ores, as well as of the tools used in treating them, and the materials of which the furnaces are composed, we come to their sampling for the determination of their exact value before treatment. A chapter has been devoted to the subject of thermo-chemistry as applied to igneous methods of extraction. The winning or reduction of the various metals is first taken up in order, and is followed by a description of the methods of refining them.

THE SLEEPING CANOPY AND THE NEED OF SUCH MEANS OF VENTILATION. By Charles Denison, A.M., M.D. Chicago, Ill.: American Medical Association.

TRANSACTIONS OF THE AMERICAN CERAMIC SOCIETY. Volume IX. Containing papers and discussions read at the meeting held at St. Louis, Mo., February 4, 5, and 6, 1907, together with some other contributions sent in subsequently. Columbus, Ohio: Published by the Society. 8vo.; paper cover.

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THE STANDARD HANDBOOK ON WINES AND LIQUORS. By Albert M. Hirschfeld. New York: William C. Popper & Co. 8vo.; cloth; 90 pages. Price, $1.50.

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LES MERVEILLES DE L'ELECTROCHIMIE. Son avenir au Perou. Par Emile Guarini. Paris: H. Dunod & E. Pinat, Libraires-Editeurs. 168 pages, 99 figures. Price, $1.

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ANNUAL REPORT OF THE DIRECTOR, 1907. Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Reprinted from Year Book No. 6, pages 154-166, plates 10 and 11.

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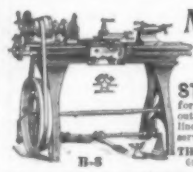
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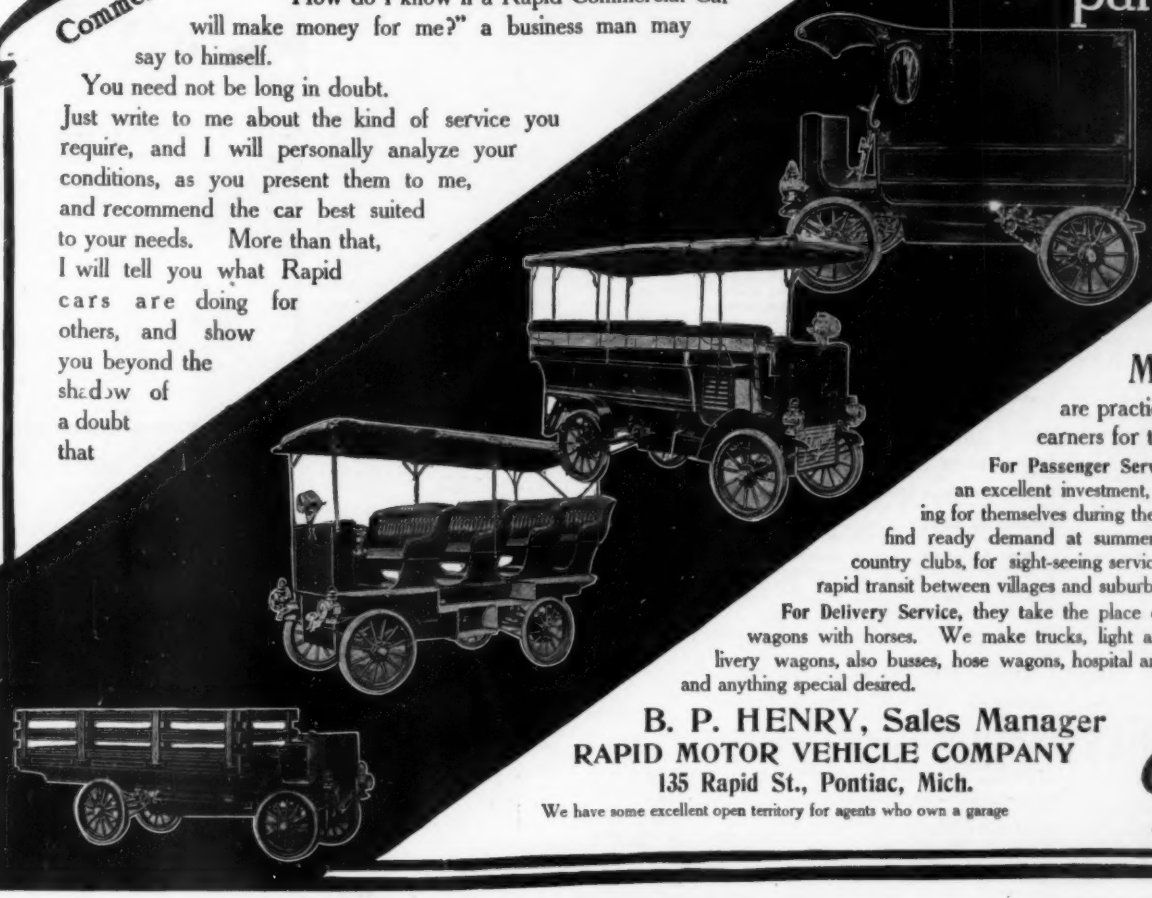

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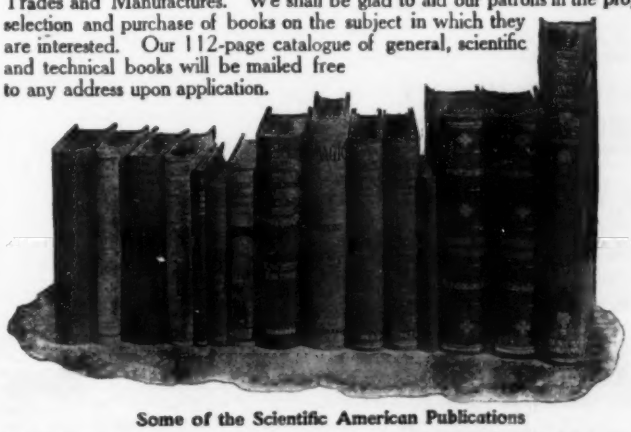

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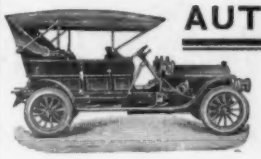

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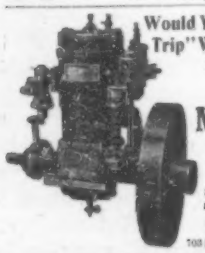

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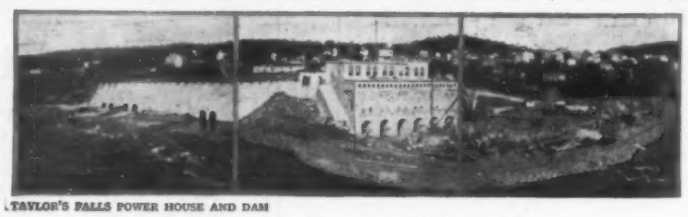

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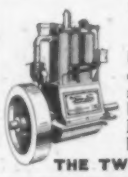

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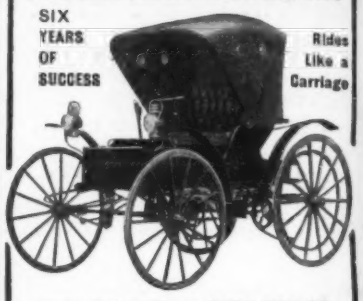

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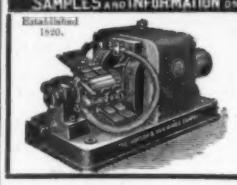

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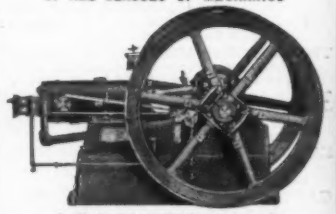

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